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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Honours Hygiene.

BY

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EFFLUVIUM NUISANCES FROM THE KEEPING OF ANIMALS.

THE 47th section of the Public Health Act prohibits the *keeping of pigs* in towns so as to be a nuisance, and, as a general rule, it is possible to obtain a magistrate's order prohibiting entirely the keeping of pigs in towns. The excreta of the pig have a very offensive and penetrating odour, and however carefully kept, pigs in towns form an intolerable nuisance.

Not only is there nuisance from the accumulation of manure and dirtiness of the piggeries, but also from the storage and subsequent preparation of food. The boiling of hog-wash is often an even greater nuisance than the filth of the styes.

Cow-keeping and *horse-keeping* in towns is still allowed and, as compared with pig-keeping, is a very small nuisance. Mews if kept clean and well drained need not be offensive, though it is very objectionable on the ground of health for persons to sleep over stables. The removal of manure also constitutes a difficulty. Bye-laws should be in force insisting on periodical removal, and the manure should not be allowed to accumulate in deep wet pits. but on an iron cage-work, allowing free drainage and keeping the manure dry, and thus reducing ammoniacal decomposition to a minimum.

Cowsheds are generally very badly ventilated, as the cowkeeper finds that more milk is produced by the cows when the temperature of the shed is maintained at 65° or higher; and he is too parsimonious to provide artificial means of warmth. The grains which are used so largely for food are stored in a wet condition, and speedily give rise to nuisance. It is important that cowsheds and stables should be well paved and well drained, as soakage of urine and semi-fluid manure into the ground gives rise to foul emanations.

Cowsheds are regulated under the Dairies', Cowsheds', and Milkshops' Order of the Local Government Board. This order provides for and insists on the registration of cowkeepers, dairymen, and purveyors of milk, by the local authority. It also provides that no cowshed or dairy shall be occupied as such, unless provision is made to the satisfaction of the local authority, for the lighting and ventilation, including air-space, and the cleansing, drainage, and water-supply of the same; and for the protection of the milk against infection or contamination. With the view of preventing contamination of milk, no person suffering from an infectious disorder, or having recently been in contact with a person so suffering, is allowed to milk cows or take any part in any stage of the business of a milk-seller.

Slaughtering of Animals.—Nuisance may arise in slaughter-houses from various causes:—(1) the uncleanly way in which animals are kept in the pound or lair before being killed; (2) the insanitary condition, bad paving, lack of lime-whiting of walls, &c., of the slaughter-house; (3) the accumulation of hides, blood, fat, offal, dung, or garbage on the premises; (4) the uncleanly condition of the blood-pits, or the receptacles for garbage; (5) the flowing of blood or offal into the drains communicating with the drains of other houses, or into the public sewer.

It may be hoped that ere long private slaughter-houses will be abolished, and it will be compulsory for all animals intended for human food to be slaughtered in public abattoirs under official supervision. When a large number of private slaughter-houses exist in different parts of a large town, it is impossible for the sanitary officials to properly supervise the slaughtering or to ensure that diseased meat shall not enter the market. The inspector may only have the opportunity of examining the flesh, the internal organs which more particularly show the presence of a diseased condition having been concealed. Such concealment and the consequent foisting of diseased meat upon the public, can only be efficiently prevented by the entire forbiddal of the slaughtering of any animal intended for food in a private slaughter-house.

Most local authorities have bye-laws regulating the slaughtering of animals. These provide for a cleanly condition of the lairs, and prevent keeping the animals longer in the lairs than is necessary for the purpose of preparation for slaughtering. They also insist on the provision of proper covered receptacles of iron or other non-absorbent material for the reception of garbage; and other similar receptacles for blood; for cleansing of the floor, &c., after slaughtering; for lime-whiting of the walls four times a year; and for other matters of detail.

For *knackers' yards* similar regulations are applicable. The boiling of the flesh and fat which goes on in these should be so arranged as to avoid the escape of offensive vapours into the external air.

In *smoking bacon*, the singeing has formed a serious nuisance. *Fish-frying* in small shops is often a most troublesome nuisance. A hopper over the pan in which the frying is conducted has not been always successful in carrying the fumes up the chimney. The frying should preferably be done in a closed outhouse, close to a chimney with a good up-draught.

The *fellmonger* prepares skins for the leather-dresser, the chief operations being taking off the wool, liming the skins, &c. The skins deprived of wool are called 'pelts.' The pelts are thrown into a pit containing milk of lime, and thence sent direct to the leather-dresser. Nuisance may arise from (1) the odour of the raw skins; (2) the ammoniacal odour from the lime-painted skins hanging in the yard; (3) the emptying and cleansing of the 'poke' or tank in which the hides are washed; (4) the foul condition of the waste lime taken from the exhausted lime pits; (5) the odour from the dirty unpaved yards.

The *leather-dresser* only deals with 'pelts,' derived from sheep-skins; the tanner with bullocks' hides. The skins brought from the fellmonger to the leather-dresser are first deprived of lime, and then soaked in a solution of dog's dung, called 'pure,' until they become soft. In winter this 'pure' solution is warmed for use. The odour is very abominable, both from the 'pure' tub, and from the discharge of the exhausted 'pure' liquid into the drain.

It is not necessary for our purpose to enter into details as to the various stages of *tanning*. At each stage nuisance may arise unless great precautions are taken, as when the hides are soaked in lime and water, when the hair is being removed, when the loose inner skin of the hide is being removed, and especially when the hides are soaked in pits containing pigeons' or other dung. Nuisance may arise again during the passage of offensive hides through the street. Cleanliness is the great rule. If every process is carried on with due precautions, including frequent washing out of receptacles, and the free use of disinfectants, little complaint need arise.

The manufacturers of *glue* and *size* boil out the gelatine from bits of hides and 'fleshings' from leather dressers and tanners, from damaged 'pelts,' ox or calves' feet, horns, and other similar substances. The raw material is apt to be offensive in collection or while accumulating on the premises. The process of boiling causes offence by the effluvia from the steam. The residue remaining after the process is known as 'scutch,' and this, unless frequently removed, is a most serious source of nuisance.

Prussiate of Potass is manufactured by heating carbonate of potass with refuse animal matters. In order to avoid nuisance the pot in which the boiling is done should have a pipe to conduct away the steam, first running horizontally and then vertically down to the back part of the flue which underlies and heats the pot.

Fat-melting and *Dip-candle-making*, as usually carried on, give rise to nuisance. The fat which is melted down usually comes from butchers and marine-store dealers in a rancid or even putrid condition, and it may be stored on the premises for some time before it is boiled. The vapours from the melting-pan are very offensive. They should be carried by means of a pipe down until they discharge just under the boiler-fire. The residue from the fat-melting process (known as 'greaves') requires frequent removal to avoid nuisance.

Bone-boiling, in order to extract the fat and gelatine, is most offensive, and most difficult to deal with. After boiling, the bones are apt to give off offensive smells. The vapours from the closed boiler should be condensed as far as possible in a worm condenser, and the remainder passed through a furnace fire.

In the manufacture of *artificial manures* nuisance is apt to arise from (1) the reception and accumulation of the raw materials, as putrid fish, putrid blood, scutch (the residue from the manufacture of glue), recently boiled bones, &c.; (2) the preparation of the raw material for use. Thus the drying of condemned fish or meat on open kilns is very offensive; similarly the drying of sewage sludge. (3) The process of mixing the materials of manufacture, irritant and offensive vapours being evolved, as for instance in the manufacture of manure by crushing bones, and converting into super-phosphate by the addition of sulphuric acid. (5) The removal of the manure from the hot den, after it has been dried. When sulphuric acid is mixed with coprolites or other mineral phosphates, most irritant and offensive vapours are produced, which may be perceived in some cases at the distance of a mile.

Blood-boiling is now almost obsolete, having been replaced by albumen-making and clot-drying. Nuisance may arise from the blood collected from slaughter-houses being in a putrid state; and from the effluvia evolved during the drying process. These processes are usually regulated by bye-laws.

Gut-scraping, *gut-spinning*, and the *preparation of sausage-skins* are very closely akin. In gut-scraping the putrid intestines are deprived of their interior soft parts by scraping with pieces of wood, and are then, after being cleansed, ready for sausage-skins. In gut-spinning the prepared gut is twisted into a cord. The small intestines of hogs and sheep are used for this purpose. The stench from these establishments is indescribably horrible. Extreme cleanliness is desirable. Immersion of the guts in common salt or chloralum solution is useful; so also the use of impervious vessels, early removal of all refuse material, &c.

Brick and ballast burning are a frequent source of complaint in the neighbourhood of towns. *Brick burning* is conducted either in kilns or clamps. When bricks are burnt in closed kilns comparatively little nuisance arises; but when they are burnt in open clamps the effluvia are very irritating, partly owing to

the fact that very commonly house refuse, containing vegetable and animal matters, is burnt with the bricks. Clamp burning should be absolutely prohibited in the neighbourhood of large towns.

In *Ballast burning* stiff clay is converted by the agency of heat into a brick-like material, which is of use in road-making. The clay is usually burnt in heaps, mixed with ashes and breeze from dust-bins. The process is offensive unless carried on with precautions similar to those for brick-burning.

(To be continued.)

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An Elementary Course in the Use of Wood Working Tools.

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EIGHTH TOOL: THE BEVEL.—We have next to describe a very important tool, viz., the bevel. Like the try-square, we see that it is made up of two principal parts, the blade and the beam. Some bevels are made without the slot. See fig. 114.

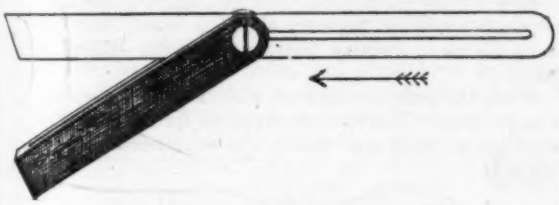


Fig. 114.

These are not of much use. They simply open and shut like a penknife.

The one before us is of the greatest use where work which is angular in character is being done. We said just now it consisted of two parts, a beam and a blade. Now this blade is made of steel, and is free to move in the slot through the whole circle, but only in one plane. It may be made by drawing the blade in the direction of the arrow, to act as a try-square, when it has been fixed at right angles. It will be plain to the pupil why this blade is not fixed. Suppose it could only move about the screw, as shown in fig. 114. When the beam was placed in position, that part of the blade which could only be utilised would lie between the screw and the angular end. But by its being free to move in the slot it is clear that when set ready for marking the whole of the blade may be brought into requisition. Again, observe the groove in the beam. When not in use it is advisable to let the blade lie in this, as damage may be done to the blade when open. The screw in the end of the beam is simply intended to give rigidity when working with the tool. Before the blade can be properly set it is advisable to unscrew one or two turns, so that it may be freely made to move to the desired angle.

How to set the tool before working next claims our attention. One of the earliest problems in geometry is the construction of angles. We purpose showing next how to obtain angles of 30°, 45° and 60° readily, so that we may set the bevel to these angles and work accordingly.

Every student will of course be provided with an ordinary set-square. Draw angle *abc* by means of it,

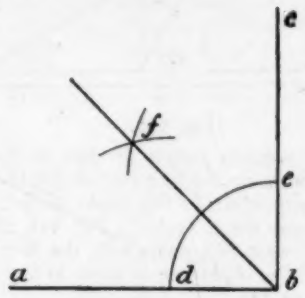


Fig. 115.

fig. 115. Take a pair of ordinary compasses and describe an arc *de* at any convenient radius. Then from *d* and *e* as centres describe any two arcs intersecting at *f*. Join *bf*. The angle *abf* contains 45°. Now take another right angle and describe an arc *de*, fig. 116.

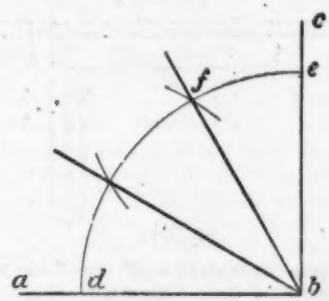


Fig. 116.

It is a well-known fact in geometry that a radius of a circle is nearly $\frac{1}{6}$ of the circumference, and if a circle contain 360° then $\frac{1}{6}$ of the circle will contain 60°. Then having described the arc *de* we step off *df*, an arc which contains 60°. Then the angle *abf*, which subtends the arc *df*, will contain 60°. Now if we have *abc* = 90°, and *abf* = 60°, then *fbc* must equal 30°.

We have then constructed angles of 30°, 45° and 60°.

This work, for sake of illustration, has been done on paper, but in actual practice we should find this method very inconvenient. So we must do our setting out, as it is called, on some board which has two faces perfectly true to each other, viz., a face side and a face edge.

Now let us suppose in fig. 117 we have the board required. Run the line *ab* along the edge and

parallel to it at a distance of ½ in. By means of a try-square we may raise the three perpendiculars, and

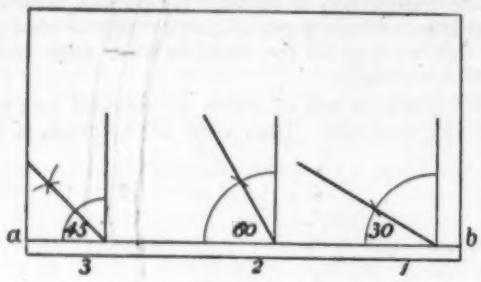


Fig. 117.

by a pair of ordinary bench dividers we may scribe the required work on the face side of the board.

Our next step is to fix the blade of the bevel to any one of these three angles. Fig. 118 shows the bevel with its beam in contact with the face edge of the board and the blade free to move in any direction round the screw axis.

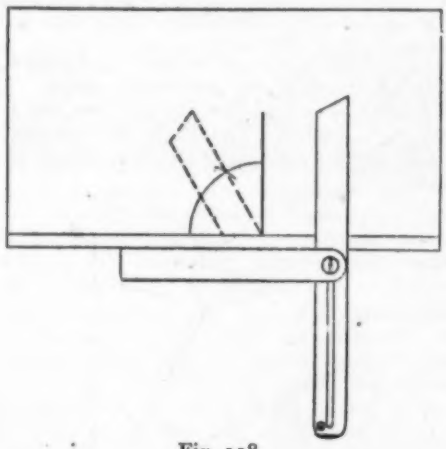


Fig. 118.

Now suppose we wish to make the blade and beam lie at an angle of 60°. Construct angle of 60° as shown in fig. 118.

Slide the bevel along the face edge, as the blade is free to move make it lie, as shown by dotted lines. Exactness is very important here, and great care should be taken to work with the greatest accuracy. It will be seen that if one angle of the bevel be set to 60° the angle on the other side of the beam will be at 120°.

To set the bevel at angles of 45° and 30° we proceed exactly in the same way.

But let us suppose now that we are required to construct an angle whose magnitude is not precisely stated, We are required, say, to work a piece of wood having an angle equal to *abc*, fig. 119.

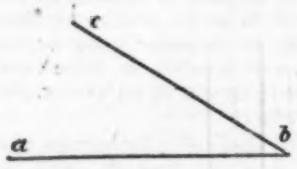


Fig. 119.

We simply draw a line parallel to our face edge, and by geometrical construction make an angle equal to it. We can then set the bevel to this angle and work accordingly.

Exercise XXVI.

To cut a mitre.—This exercise is readily accomplished when a mitre-board is at hand. In its absence we must work the exercise as follows:—

Take a block 8 in. × 2 in. × 1 in., and true-up all the faces. We wish to cut this block into two equal parts, but at an angle of 45°.

Find the centre and square over a line. Then half of this will be at a distance of 1 in. from the edge. It is through this point we wish to cut in a plane which lies at an angle of 45° with the face edge. Set the bevel to 45°, and mark off as before. Fig. 120 shows the block prior to sawing.

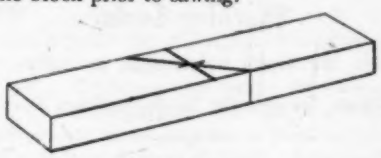


Fig. 120.

It will assist in guiding the saw if the lines are marked over on all sides.

After marking, place the block upon the bench hook and saw through at the angle marked, viz., 45°.

Now we require to shoot the ends, and we find this impossible with an ordinary shooting board, but on using the mitre shooting board we find our difficulty gone.

When the ends are shot we have a joint known as a mitre joint. This appears in picture frames, casings, beadings on walls and doors, and in windows. See fig. 121.

Fig. 121.

When the joint is nicely made, take a bradawl and bore a hole ½ in. from the edge and through both pieces. Make a peg, and glue joint and knock in the peg, which has been glued also. A good joint will then be obtained.

Exercise XXVII.

To make a tea-pot stand. In this exercise we shall bring in a new tool, viz., the rebate plane. In fig. 122 we have a rebate plane.

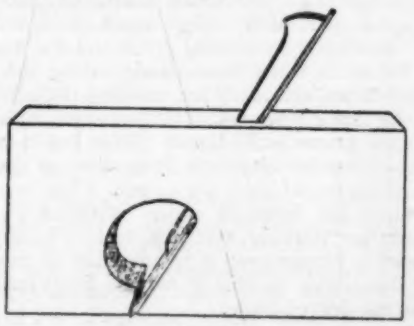


Fig. 122.

NINTH TOOL: REBATE PLANE.—It consists of a stock, blade and wedge. The mouth of the plane is sometimes at right angles to the sides, and when this is the case it is named a straight or square rebate. The mouth in some is at an angle to the sides, and is then known as a skew or angular rebate plane. Both of these forms are common. It will also be observed that the cutting edge of the iron, which is shown in fig. 123, lies also with the mouth square or skew.

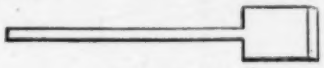


Fig. 123.

It is used very much in the same way as the ordinary smoothing plane, and may, with advantage, be employed in clearing interior angles. There is one obvious difference between the ordinary planes and the rebate planes. The blades of the latter extend across the whole of the sole, while in the smoothing, jack and trying planes the blades are less in width than the soles. The obliquity of the irons in the rebates produces a surface which is more acceptable than when we employ the square rebate. The latter, however, is essential in certain manipulations.

We require for this exercise a block of mahogany 3 ft. long 2 in. wide and $1\frac{1}{2}$ in. thick. This must be obtained and planed down and trued to the above measurements. On the face side and edge gauge a line $\frac{1}{4}$ in. wide down the whole length. It will be seen on referring to fig. 124 (which gives us front and end elevation) what we are required to remove by means of the rebate plane.

Fix block on the bench and plane down to gauge lines by means of rebate plane, so that when finished we have in end section what we see in fig. 124.

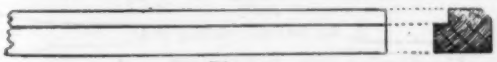


Fig. 124.

We now require this cutting in such a way that we must have four perfect mitres. Set the bevel as before to 45°, and from the end of block, as shown in figure 125, draw line as indicated.

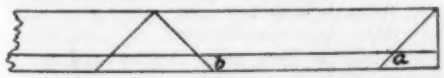


Fig. 125.

We propose to fit into this frame a till which is 6 in. square and $\frac{1}{2}$ in. thick. We cut the end off by tenon saw on the bench hook. From point *a* mark off a point *b* 6 inches, and set the bevel and mark off again. Cut off as before. Repeat this until we have four pieces, which when shot on the mitre board and fitted together will appear as in figure 126.

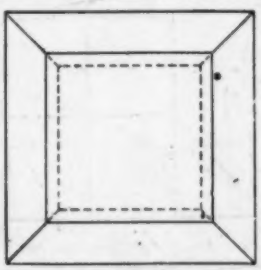


Fig. 126.

Each corner will require gluing and pegging as before.

We now make four feet, one of which is shown in fig. 127. This consists of two pieces, mitred as

Fig. 127.

shown, 2 inches in length, and $\frac{1}{2}$ in. square. These are glued and sprigged on as indicated in figure 128.

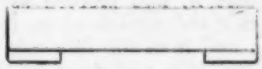


Fig. 128.

A fancy tile should now be obtained, and after gluing the inner ledge it may be fitted in, and the upper part of it will just come flush with the surface of the frame. A little size, and afterwards varnish, applied to it will furnish a very desirable addition to the tea table.

It may be made a little more artistic by taking off the corners by the smoothing plane before being glued together, as shown in fig. 124.

Exercise XXVIII.

Simple halving. If we refer to fig. 129 we see at once what is meant by simple halving. We find that

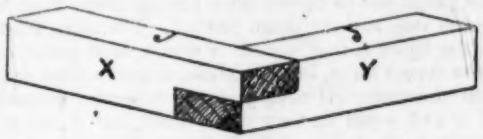


Fig. 129.

the face side of the piece *x* is exactly flush with the face side of piece *y*. In order to do this we must remove from each piece exactly one-half of the matter, as shown in the figure. To do this we proceed as follows:—Take a block 12 in. × 2 in. × $1\frac{1}{2}$ in. True this block up and cut into two. Each piece will now be six inches long. Mark one piece *x* and the other *y*. We see therefore that the lower half of *x* to the width of *y* needs removing, and the upper half of *y* to the width of *x* needs removing. It is advisable to put the face side and face edge marks on each piece so that the work may be accurate.

Place *x* upon *y*, as we see in fig. 130, which only gives the plan.

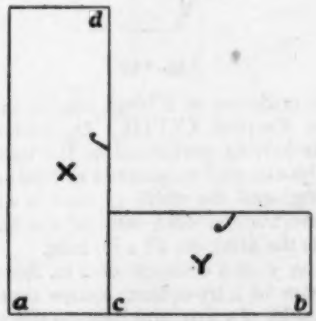


Fig. 130.

Be very careful to have the side of the piece *x* exactly flush with the end of *y*. Now take the try-square and gently slide the blade along, having the beam of the square lying against the side marked *ab* in the fig. Let the blade rest when it comes in contact with the face edge of *x*, marked *cd* in the figure.

Now remove piece *x* and be careful not to move the try-square in the slightest. Take the scriber and mark off a line on the face side of *y*. Continue this line on all four sides.

Now do the same for piece *x*, but this time put piece *y* on piece *x*, and proceed as before. We said the pieces *x* and *y* were 1½ in. thick. Set the gauge to ¾ in., and from the face side only gauge a line over the end of *x* and down to the line which has already been taken round the four sides. When

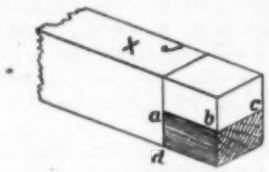


Fig. 131.

this is done it must be repeated on *y*. Fig. 131 shows what *x* is like when ready for sawing. Now place piece *x* in the vice and saw down the line *abc* by means of the tenon saw, taking great care just to keep the gauge line in sight. Now put the piece *x* on the bench stop and saw down line *ad*. The piece shaded in the figure is that part of *x* which must come out. Now repeat for *y*, but be careful to cut out the upper half this time. If sawing is well done the face sides of *x* and *y* will be very nearly flush, but if not they can be made so by a little judicious chiselling.

Exercise XXIX.

Closed halving. Most of the pupils will have seen what is known as an 'Oxford frame.' In this we have a good example of what is known as 'closed halving.'

Fig. 132 shows us the closed halving.

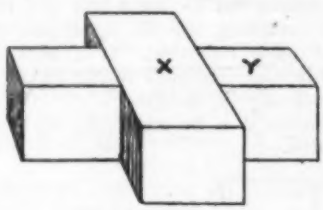


Fig. 132.

We have made use of a block exactly similar to the one used in Exercise XXVIII. In Exercise XXIX. we have the halving performed in the middle of the individual blocks, and we proceed as follows: *x* and *y* are 6 in. long, and the width of each is 2 in., so that we shall have 2 in on each side of the halving. In other words the arms are all 2 in. long.

Place *x* on *y* at a distance of 2 in. from the end, and, by means of a try-square, square over two lines on all four sides of *y* first, and then do the same for *x*. See fig. 133.

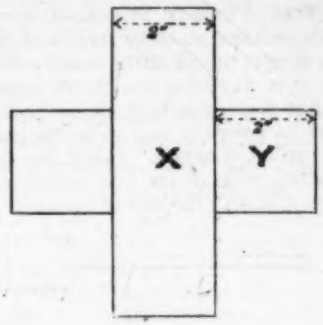


Fig. 133.

When done, gauge a line ¾ in. from face side of *y* on two sides, as shown in fig. 134. The part shaded requires removing, and this must be done as we did

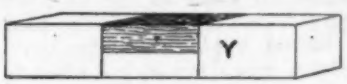


Fig. 134.

in Exercise XXII., fig. 103. Do the same for *x*, but in this case take out the lower half. Remove any irregularity by applying the chisel until a good fit has been obtained, as in fig. 132.

(To be continued.)

—o—

Practical Perspective for Pupil Teachers.

BY

E. G. BAKER, B.SC., B.A.,

Vice-Principal of the Training College, Carmarthen.

We now proceed to carry our last lessons a step further and project solids which are pierced by others. There will be no new principle involved, though there will be more details requiring attention; and the student must accustom himself to distinguish the various surfaces from one another and determine accurately on which surface any points required lie.

Exercise.—In fig. 56 is given the elevation to half scale of a rectangular slab 1½ ft. thick, standing vertically on the ground plane on the base AB.

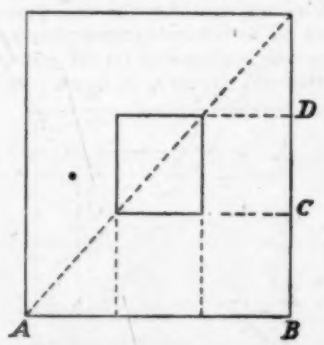


Fig. 56.

Through the centre of the slab passes a rectangular prism which projects 2 ft. from each of the vertical faces it pierces.

The projection is that for a spectator 4 ft. high and standing 8 ft. away from the picture plane, the corner A being 1 ft. to the left and 1 ft. in the picture, while AB recedes from the ground line towards the right at an angle of 45°.

To obtain the projection of the prism, first draw its plan across the plan of the slab, the width being obtained from the elevation given, and the length being determined by the fact that it has to project two feet from each of the vertical faces it pierces.

Neglect the slab already projected, and project the prism by means of two picture lines, the positions of which are obtained by doubling BC and BD.

All that now remains to be done is to find the points on the vertical faces of the slab at which the long edges of the prism enter and leave. These, in this case, are found to be on the diagonals of the vertical faces of the slab. Draw the

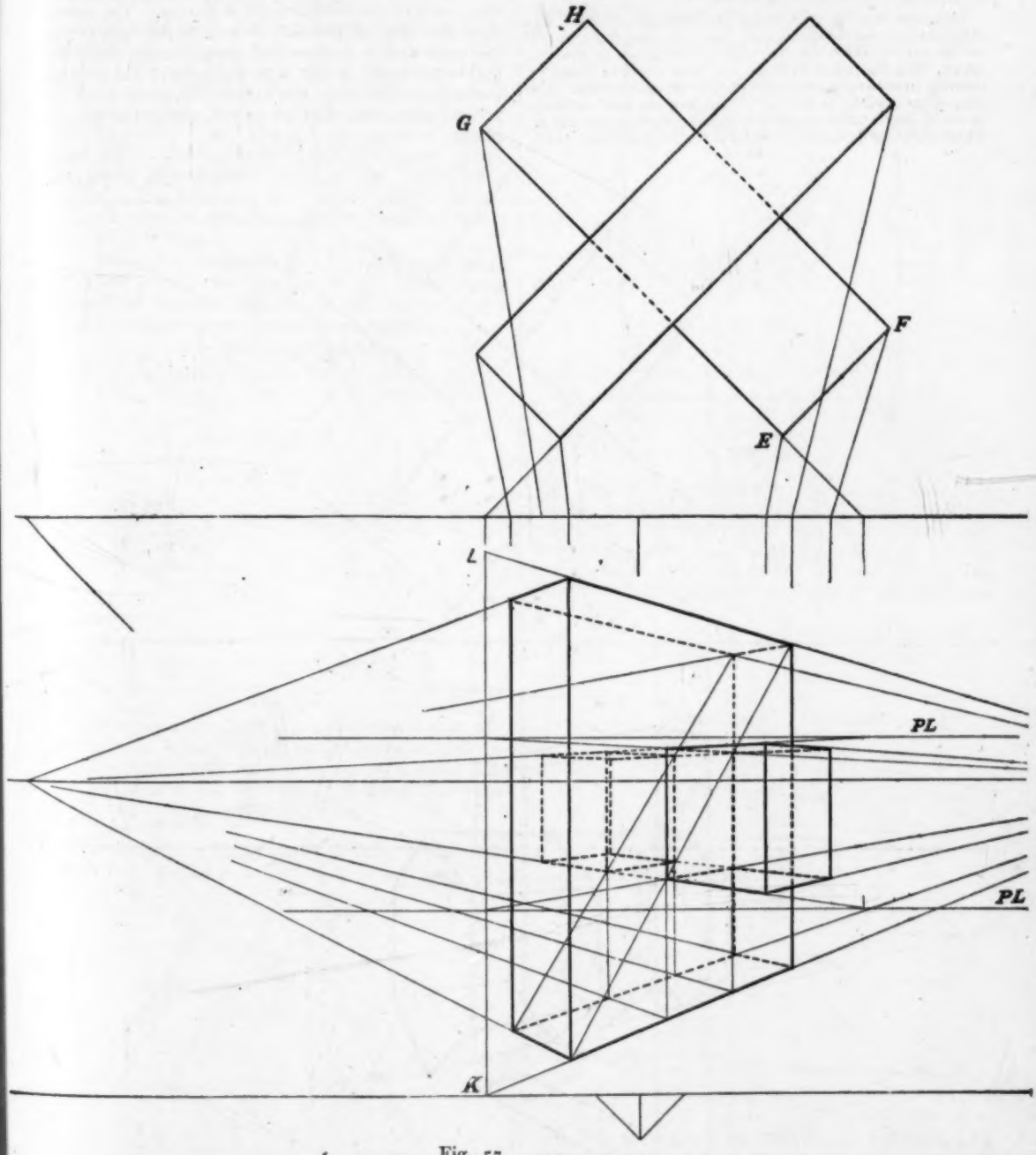


Fig. 57.

The solution of the above, which is given in fig. 57, we will describe in detail. First draw the plan of the slab and project it as usual.

diagonals, therefore, of each face, and note the points of intersection of the long edges and the diagonals. Then complete the projection as shown.

The above method of obtaining the lines of intersection of the faces of the slab and prism is the shortest in this case, because the angles of the elevation of the prism are on the diagonals of the elevation of the slab. But as this is not always the case, we give another method of projecting the prism, a method which is always applicable, and which is based on the solution shown in fig. 52 (1).

The student is advised to work the problem again, according to the following method :—

First, note from fig. 57, in which both methods are shown and discovered to give the same result, that if the lines from the VP on the left on which the long edges of the prism lie could be drawn, then the points E, F, &c., on them could be found by drawing from those points in the plan to the station point. The method then will be as follows: First draw the small rectangle shown in the elevation on the two opposite faces of the slab by means of the vertical and horizontal dotted lines as in fig. 52 (1), making use of the height line KL. The lines joining corresponding angles of the two figures thus drawn, will meet in the VP on the left, and on them the long edges of the prism lie. Draw from E, F, G and H in the plan to the station point, and the perpendiculars from the ground line will give the ends of the prism.

The second of the above methods we will illustrate by one more solved exercise.

EXERCISE. The fig. 58 is the front elevation to half scale of a vertical slab, 1 ft. thick, pierced through its centre by a hexagonal prism, which projects 2 ft. from each of the vertical faces it pierces. The corner A of the base of the slab is 2 ft. to the right of the spectator and 1 ft. from the picture plane, while AB makes an angle of 40° with the ground line towards the right. The spectator stands 8 ft. away from the picture plane and his eye is 5 ft. above the ground plane.

Scale $\frac{1}{2}$ in. to the foot.

Fig. 58.

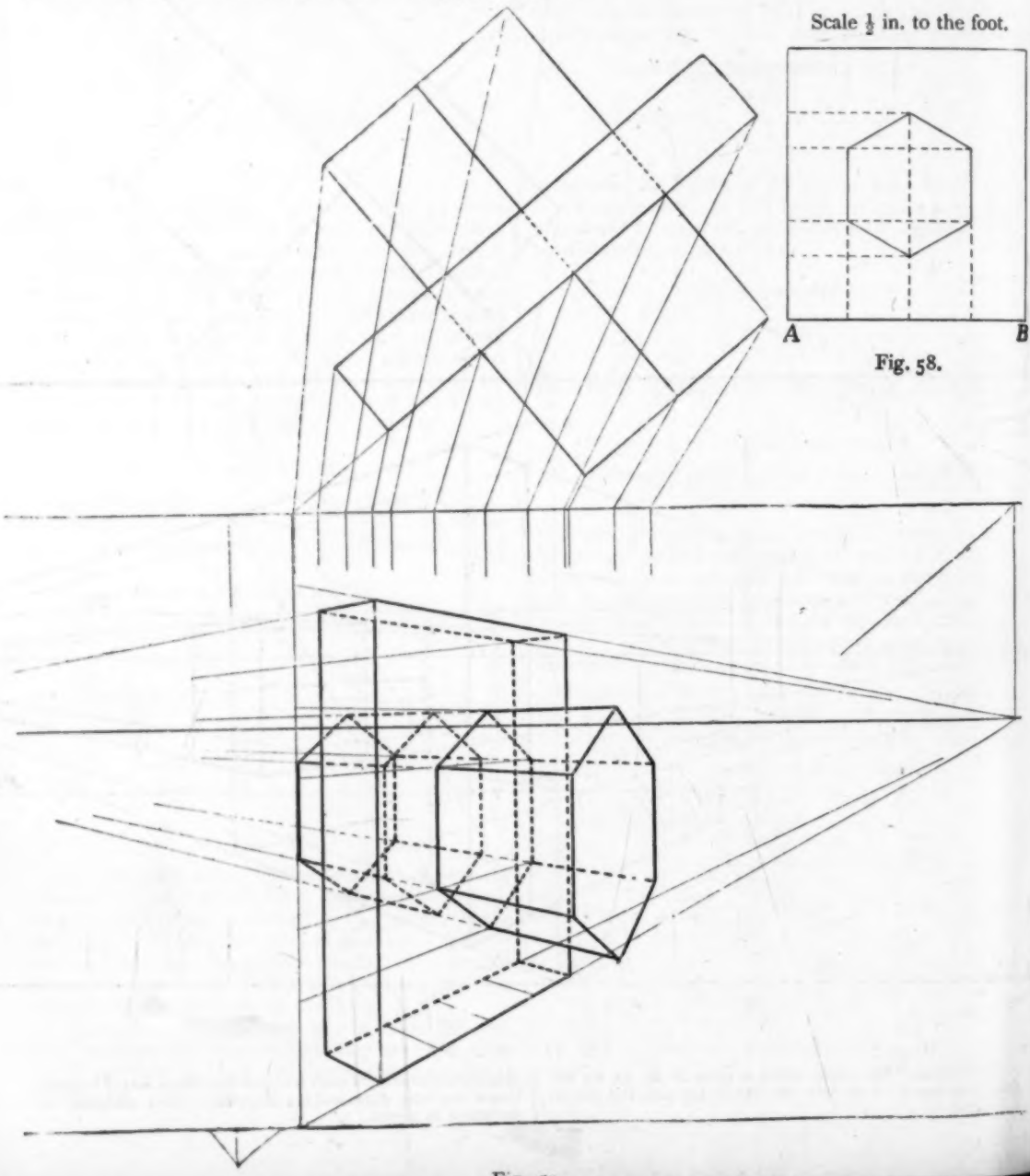


Fig. 59.

Directions.—First draw the plan of the slab and prism, that of the latter by means of the vertical dotted lines shown in the elevation. Next project the slab and obtain a hexagon on each vertical face, as in preceding exercises, by means of a height line, &c. The remainder of the solution is exactly as in the second method of the last exercise.

PROBLEMS.

Spectator 11 ft. from the picture plane. Height of eye above the ground plane, 5 ft.

Scale ½ in. to 1 ft.

1. Draw the projection of a vertical slab, 7 ft. high, standing on a base 4 ft. long and 1 ft. wide. The nearest corner of the base is 1 ft. to the left and 3 ft. in the picture and from it one of the long sides of the base recedes towards the right at an angle of 50° with the ground line. Through the centres of the two larger vertical faces passes the axis of a square prism, two sides of each square end of the prism being vertical. The prism is 5 ft. long and projects equally on both sides of the slab. The sides of the square ends are 3 ft. long.

2. Draw the projection of the slab and prism described above, the position of the prism being changed so that one diagonal of each square end is vertical, everything else remaining as before.

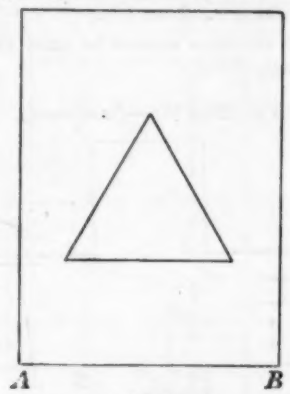


Fig. 60.

3. Fig. 60 is the front elevation to half scale of a vertical slab standing on the ground plane on the base AB, the corner A being 2 ft. to the right and 2 ft. in the picture and AB receding from the picture plane at an angle of 35° towards the right. The slab is 1 ft. thick.

The triangle represents a right prism piercing the slab and projecting 2 ft. from each vertical face.

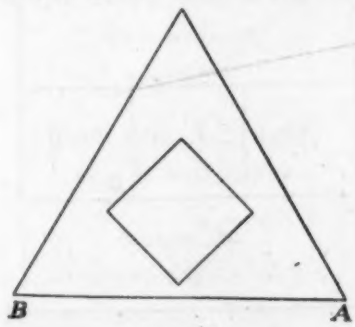


Fig. 61.

4. Fig. 61 is the front elevation of a triangular slab 1½ ft. thick, pierced by a square prism which projects 2 ft. from each face. The drawing is to half scale.

Project the two solids, supposing the corner A of the base AB to be 1 ft. to the left and 3 ft. in the picture, AB receding from the ground line towards the left at an angle of 40°.

For the following problems, the spectator is supposed to be 12 ft. away from the picture plane, his eye being 6 ft. above the ground plane.

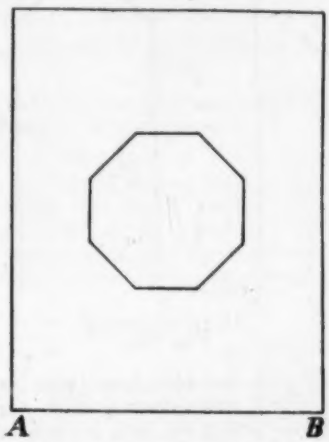


Fig. 62.

5. Fig. 62 is the front elevation to half scale of a vertical block, 2½ ft. thick, pierced by a right octagonal prism, which projects 1½ ft. from each vertical face. Project the same, supposing the corner A on the ground plane to be 4 ft. to the left and 1 ft. in the picture and AB to make an angle of 90° with the ground line.

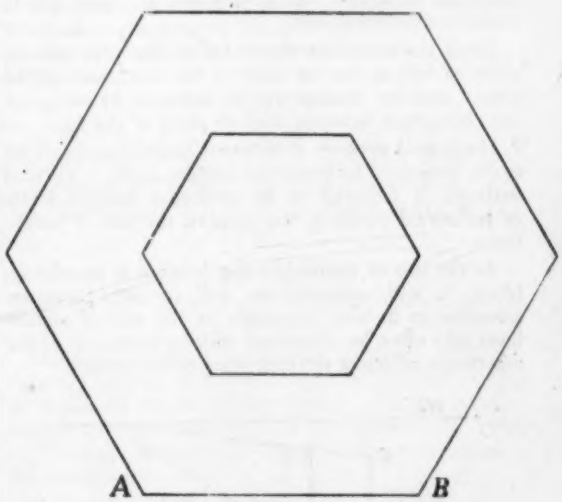


Fig. 63.

6. Fig. 63 is the front elevation to full scale of a hexagonal block, 3 ft. thick, pierced by a hexagonal prism 7 ft. long, the prism projecting equally from opposite vertical faces of the block. Project the

solids, supposing AB to be on the ground plane, and to make an angle of 80° with the ground line towards the right, while the nearest corner of the block is 3 ft. to the left and 1 ft. in the picture.

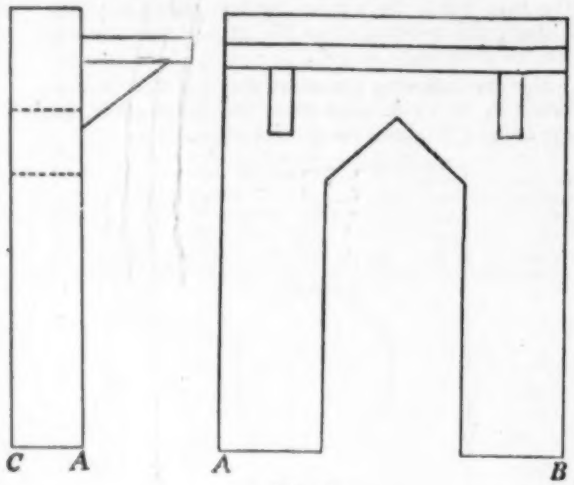


Fig. 64.

7. Fig. 64 gives two elevations (front and end) of a portion of a wall with a doorway in it. Above the doorway, on one side of the wall, is a projecting ledge supported on two projecting stones. The drawings are half size. Make a perspective drawing of the wall, &c., the corner A to be 2 ft. to the left of the spectator and 1 ft. in the picture, and AB to recede from the ground line towards the right at an angle of 45°.

The plan will be for the wall itself a rectangle with sides equal to twice AB and twice AC. The doorway is to be regarded as a fig. on each of the vertical faces of the wall, as in preceding exercises. The plan of the projecting ledge should next be added and projected by means of picture lines, or it may be treated as a projecting solid.

In all the exercises which follow the plan will be given as well as one or more of the elevations of the object, and the student will be required to recognise the connection between the two parts of the fig.

Horizontal surfaces at different levels can always be easily projected by means of picture lines. Vertical surfaces, if required to be projected independently of horizontal surfaces, will require the use of height lines.

As the use of the *height line* is often a stumbling-block, it will, perhaps, be well to call particular attention to its use, especially as the use of picture lines may often be dispensed with by means of it, the advantage of fewer working lines being secured.

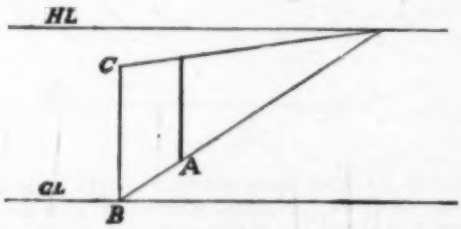


Fig. 65.

Let fig. 65 represent the ground line and horizontal line on the picture plane.

All vanishing points for horizontal lines are on the horizontal line.

Suppose A the projection of a point on the ground plane, *i.e.*, on the level of the ground line. It is required to draw the projection of a vertical line at A, the line being 4 ft. long.

Take any point V on HL, join VA and produce it to meet GL. The line VA is the projection of a horizontal line through A, and since A is on the ground plane the line VA is in that plane and will therefore intersect GL. Let it meet GL in B. At B draw BC vertically and 4 ft. long. From C draw to V. Now V and VC are horizontal lines and vertically above each other, *i.e.*, VCB is a vertical plane. Moreover, VC and VB are parallel lines, since they vanish to the same point. Therefore any vertical line between them is the projection of a line 4 ft. high. Draw the vertical between them from A, and the line required is obtained. It is of great importance to note that if A had not been on the ground, but at a different level, *e.g.*, 2 ft. above the ground, then the horizontal line VA could not intersect the ground line, since it is not on the ground; it must be drawn to a picture line 2 ft. above GL.

Too much attention cannot be paid to the above theory of height lines.

PROBLEMS—*(continued).*

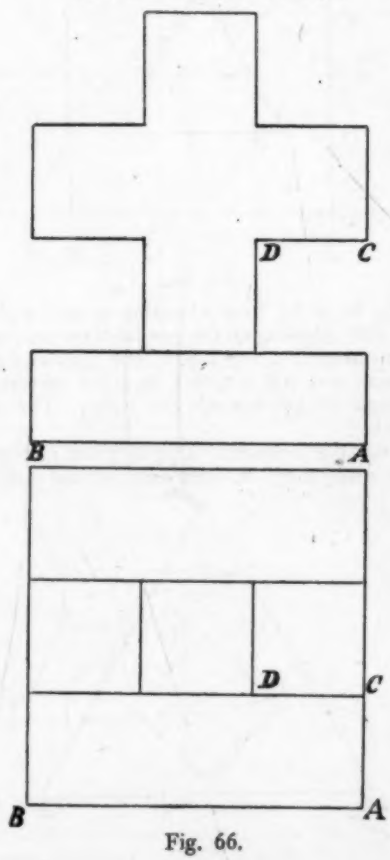


Fig. 66.

8. Fig. 66 gives the plan and an elevation to half scale of a solid cross on a square block. Draw the perspective projection of it, supposing A to be 1 ft. to the right of the spectator and touching the picture plane, and AB to recede from the ground line towards the left at an angle of 40°.

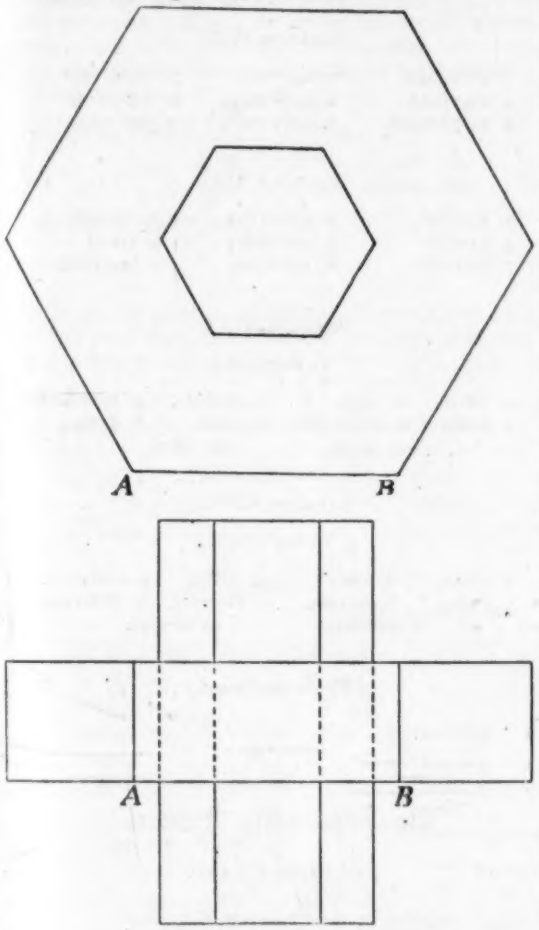


Fig. 67.

9. Fig. 67 gives the plan and front elevation of a hexagonal slab pierced by a hexagonal prism. The edge AB of the base of the slab makes an angle of 45° with the ground line towards the right, and A is 2 ft. to the right and 2 ft. in the picture.

(To be continued.)

—o—

Contracted Arithmetic.

BY J. L. RICHARDSON.

Section XL.

Multiplication of Circulators.

In addition and subtraction of circulating decimals the mode of obtaining approximately correct results by extension of the repetends is generally practised, but it is not so well known that a modification of the same principle is available in multiplication also. In this and the two succeeding sections explanatory examples are given of three phases :—

1. With one circulator, and multiplier not exceeding twelve.

2. With several circulators, and multiplier not exceeding twelve.

3. With several circulators, and multiplier above twelve.

Section XLI.

With One Circulator, and Multiplier not exceeding Twelve.

Proceed as in simple multiplication, but add in the carrying figure of the circulator.

Example :—$346.\dot{7} \times 5$.

To the product of 7×5 we add the carrying figure 3, which makes 38. Putting down the 8, we proceed as in ordinary multiplication, placing a dot over the 8, and the decimal point in the usual place.

$$\begin{array}{r} 346.\dot{7} \\ \underline{\quad\quad 5} \\ 1733.\dot{8} \end{array}$$

Exercise XLIII.

1. $92.\dot{7} \times 6$.
2. $84.\dot{5} \times 12$.
3. $76.64\dot{8} \times 5$.
4. $96.748\dot{9} \times 7$.
5. $96.74\dot{3} \times 8$.
6. $71.893\dot{3} \times 6$.
7. 81.48×7.
8. 81.76×5.
9. $24.61\dot{7} \times 4$.
10. $91.74\dot{8} \times 8$.

Section XLII.

With several Circulators, and Multiplier not exceeding Twelve.

Multiply as before, but add to the right hand digit of the answer the carrying figure from the left hand circulator.

Example :—$70.\dot{9}2\dot{4} \times 5$.

Here we say five fours are twenty, which, with the carrying figure 4 from five nines, make 24. Then proceed as in the last example.

$$\begin{array}{r} 70.\dot{9}2\dot{4} \\ \underline{\quad\quad 5} \\ 354.\dot{6}2\dot{4} \end{array}$$

Exercise XLIV.

1. $346.7\dot{1}2\dot{4} \times 6$.
2. $34.\dot{7}5\dot{8} \times 7$.
3. $62.4802\dot{3} \times 8$.
4. $549.\dot{3}24\dot{8} \times 9$.
5. $289.341\dot{2}\dot{7} \times 5$.
6. $98.7642\dot{3} \times 4$.
7. $492.56\dot{3}48\dot{9} \times 3$.
8. $569.0418\dot{3}5\dot{7} \times 7$.
9. $927.641\dot{2} \times 8$.

Section XLIII.

With several Circulators, and Multiplier exceeding Twelve.

Multiply as above, adding in the left hand circulator's carrying figure in every line. Before adding up make all the circulators equal. Finally, increase by one the right hand digit of the answer, and mark off the same number of decimals and circulators as in the multiplicand.

Example :—$42.\dot{3}6\dot{5} \times 856$.

The commas mark the true notational point of the recurring decimal in each line, showing what digits are to be repeated in equalising the circulators.

$$\begin{array}{r} 42.\dot{3}6\dot{5} \\ \underline{\quad\quad 856} \\ 254,191 \\ 211,\overline{8268} \\ 338,92\overline{392} \\ \underline{36264.75\dot{2}\ (+1)} \end{array}$$

EXERCISE XLV.

1. $7.\dot{6}43\dot{8} \times 23$.
2. $27.64\dot{2} \times 64$.
3. $2.76\dot{1} \times 48$.
4. $.39\dot{0}\dot{1} \times 31$.
5. $60.\dot{2}3\dot{4} \times 94$.
6. $4.9\dot{1} \times 85$.
7. $8.76\dot{5} \times 781$.
8. $6.80\dot{1}\dot{2} \times 135$.
9. $71.09\dot{5} \times 625$.

SECTION XLIV.

Decimal Division.

Division to a given number of places may be accomplished as follows:—Proceed as usual till the first few figures of the answer are obtained. Then cease to bring down the remaining figures of the dividend, or to add cyphers to the remainder. Mark off, instead, the figure to the right of the divisor, and continue the division. After every division cut off another digit from the divisor, and work with the remaining figures. To the various subtrahends must be added the carrying figures from the omitted digits in the divisor.

Example:—$31{\cdot}423 \div {\cdot}456234$ to five places.

```
·456234)31·423000(68·87475
        27 37404
        ---------
         4 048960
         3 649872
         ---------
           399088
           364987
           ------
            34101
            31936
            -----
             2165
             1824
             ----
              341
              319
              ---
               22
               20
               --
```

Making the decimals equal by adding three cyphers to the dividend, we find the first two digits of the quotient in the usual way. At this point, however, instead of attaching a cypher to the remainder, we cut off the four on the right of the divisor, and find how often 45623 is contained in 399088, not forgetting to add 3, the carrying figure from the omitted 4, to the next subtrahend, making the latter 364987. We pursue the same course with the rest of the sum, till we have left only 22 as dividend and 4 as divisor.

EXERCISE XLVI.

Work to four places:—

1. $2{\cdot}50 \div 3{\cdot}2$.
2. ${\cdot}10584275 \div {\cdot}325$.
3. $14 \div {\cdot}7854$.
4. $172{\cdot}9 \div {\cdot}142$.
5. ${\cdot}0257 \div {\cdot}0041$.
6. $325{\cdot}46 \div {\cdot}0187$.
7. $33{\cdot}64472 \div 882$.
8. $25{\cdot}64 \div 3{\cdot}645$.
9. ${\cdot}865439 \div {\cdot}156$.
10. $79 \div 3965$.

EXERCISE XLVII.

Work the following by the Italian method—correct to four places:—

1. $369{\cdot}425 \div 47$.
2. $4{\cdot}4982 \div 49$.
3. $3{\cdot}8134 \div 46$.
4. $32675 \div 7{\cdot}918$.
5. ${\cdot}68975 \div {\cdot}09876$.
6. $198{\cdot}67 \div 9{\cdot}875$.
7. $8067 \div 9{\cdot}843$.
8. $765 \div {\cdot}0976$.
9. $38{\cdot}107 \div {\cdot}075$.
10. $51{\cdot}247 \div {\cdot}813765$.

ANSWERS.

EXERCISE XLIII.

1. 556·6.
2. 1014·6.
3. 383·24.
4. 677·2429.
5. 773·946,
6. 431·359.
7. 570·41.
8. 408·83.
9. 98·471.
10. 733·991,

EXERCISE XLIV.

1. 2080·2744.
2. 243·310.
3. 499·84190.
4. 4943·9234.
5. 1446·70635.
6. 395·05694.
7. 1477·690468.
8. 3983·292850$\dot{1}$.
9. 7421·1299.

EXERCISE XLV.

1. 175·6018.
2. 1769·115.
3. 132·555.
4. 12·0959.
5. 5662·608.
6. 418·13.
7. 6845·967.
8. 918·1729.
9. 44434·974.

EXERCISE XLVI.

To four places.

1. ·7812.
2. ·3256.
3. 17·8253.
4. 1217·6056.
5. 6·2682.
6. 17404·2780.
7. ·0381.
8. 7·0342.
9. 5·5477.
10. ·0199.

EXERCISE XLVII.

To four places.

1. 7·8601.
2. ·0917.
3. ·0829.
4. 4126·6734.
5. 6·9841.
6. 20·1184.
7. 819·5672.
8. 7838·1146.
9. 508·0933.
10. 62·9752.

(To be continued.)

My Scholarship Answers.

BY GEORGE WARD.

(First on the Scholarship List, 1890.)

Arithmetic.

1. (*a*) When the method of short division is employed in cases of inexact division by breaking up the divisor into factors, explain how the *remainder* is obtained. Divide 319 by 42 ($2 \times 3 \times 7$) to explain your rule.

(*b*) Resolve 6006 and 7854 into their prime factors; deduce their greatest common measure, and *prove* (as to a class of children) that your answer *is* the greatest common measure.

(*c*) Calculate the value of ·72 in the form of a vulgar fraction, without making use of the ordinary rule.

(*a*) Take the example thus:—

42 { 2 | 319 units
   { 3 | 159 twos + 1 unit
   { 7 | 53 sixes + 0 twos + 1 unit
   7 forty-twos + 4 sixes + 0 twos + 1 unit.

Therefore the answer is 7 + 25, and deduce *Rule*. Multiply each remainder (commencing from the last) by all the preceding divisors—*i.e.* $(4 \times 3 \times 2 = 24) + (0 \times 2) + 1 = 25$, and add these numbers to obtain the final remainder.

(*b*)

2	6006	2	7854	
3	3003	3	3927	Prime factors therefore are :—
7	1001	7	1309	$6006 = 2.3.7.11.13.$
11	143	11	187	$7854 = 2.3.7.11.17.$
	13		17	

Children now see that the *common* measure is $2.3.7.11 = 42 \times 11 = 462$; again, since 462 is the *greatest* number which exactly divides 6006 (462×13) and 7854 (462×17), (and 13 and 17 have no common factor but unity), therefore 462 is the G.C.M.

(*c*) Let the vulgar fraction $= a$. Then $a = .72$.

$\therefore 10a = 7.2222\ldots\ldots$ad infin. (1)

and $100a = 72.2222$ ...ad infin. (2)

By subtracting (1) from (2) $\therefore 90a = 65$, $\therefore a = \frac{65}{90}$ or $\frac{13}{18}$.

Q.E.D.

2. How many payments of 12s. $9\frac{3}{4}$d. amount to £30 2s. $2\frac{1}{4}$d.; and how many plots, each containing 3 ro. 20 pls. 20 sq. yds., are there in 41 ac. 1 ro. 11 po. $2\frac{1}{4}$ sq. yds.?

s.	d.	£	s.	d.
12	$9\frac{3}{4}$	30	2	$2\frac{1}{4}$
12		20		
153 pence		602 shillings		
4		12		
615 farthings		7226 pence		
		4		
		28905 farthings		

615)28905(47
2460
4305
4305

∴ 47 payments = Ans.

rds.	po.	sq yds.
3	20	20
40		
140 pls.		
$30\frac{1}{4}$		
4220		
35		
4255 sq. yds.		

acrs.	rd.	pls.	sq. yds.
41	1	11	$2\frac{1}{4}$
4			
165 rds.			
40			
6611 pls.			
$30\frac{1}{4}$			
$198332\frac{1}{4}$			
$1652\frac{3}{4}$			
199985 sq. yds.			

4255)199985(47
17020
29785
29785

∴ 47 plots = Ans.

3. Find by practice the value of 119 tons 18 cwt. 1 qr. 11 lbs. at £4 13s. 4d. per ton.

		£	s.	d.	
Of 1 ton 10 cwt.	½	4	13	4	price of 1 ton
		119			
		555	6	8	,, 119 tons
,, 10 cwt. 5 cwt.	¼	2	6	8	,, 10 cwt.
,, 10 cwt. 2 cwt.	⅛	1	3	4	,, 5 ,,
,, 2 cwt. 1 cwt.	⅛		9	4	,, 2 ,,
,, 1 cwt. 1 qr.	¼		4	8	,, 1 ,,
,, 1 qr. 7 lbs.	¼		1	2	,, 1 qr.
,, 1 qr. 4 lbs.	½			$3\frac{1}{2}$	,, 7 lbs.
				2	,, 4 ,,

£559 12 $3\frac{1}{2}$,, of 119 tons 18 cwt. 1 qr. 11 lbs. = Ans.

4. If 3 cwt. 2 qrs. 6 lbs. 5 ozs. of tobacco can be bought for £92 18s. $9\frac{1}{2}$d., how much of the same kind can be bought for £2 13s. 1d.?

As £92 18s. $9\frac{1}{2}$d. : £2 13s. 1d. :: 3 cwt. 2 qrs. 6 lbs. 5 ozs. : x

20 / 1858 (s.) / 12 / 22305 (d.) / 2 / 44611 ($\frac{1}{2}$-d.)

20 / 53 (s.) / 12 / 637 (d.) / 2 / 1274 ($\frac{1}{2}$-d.)

4 / 14 qrs. / 28 / 118 / 28 / 398 lbs. / 16 / 2393 / 398 / 6373 ozs.

$$\therefore x = \frac{\overset{182}{\cancel{1274}} \times \overset{1}{\cancel{6373}}}{\underset{7}{\cancel{44611}}} = 182 \text{ ozs.}$$

∴ 11 lbs. 6 ozs. = Ans.

5. Simplify—

$$\frac{\frac{63}{62} - \frac{62}{63}}{\frac{93}{92} - \frac{92}{93}} \times 16\tfrac{1}{16}$$

$$= \frac{\frac{(63)^2 - (62)^2}{62 \times 63}}{\frac{(93)^2 - (92)^2}{92 \times 93}} \times 16\tfrac{1}{16}$$

$$= \frac{\frac{(63 + 62)(63 - 62)}{62 \times 63}}{\frac{(93 + 92)(93 - 92)}{92 \times 93}} \times 16\tfrac{1}{16}$$

$$= \frac{\overset{25}{\cancel{125}}}{\underset{31}{\cancel{62}} \times \underset{21}{\cancel{63}}} \times \frac{\overset{1}{\cancel{2}} \times \overset{1}{\cancel{3}}}{\underset{185}{\cancel{92} \times \cancel{93}}} \times \frac{\overset{1}{\cancel{21}}}{\underset{1}{\cancel{46}}} = 2\tfrac{1}{2}$$

∴ 25 = Ans.

7. A square field contains 21 acs. 3 rds. 1 po.; how long will it take a man to run round the boundary at the rate of $7\frac{1}{2}$ miles an hour?

21 acres 3 rds. 1 po.
4
87 rds.
40
3481 sq. pls.

Take sq. root of 3481 sq. pls. to find the side.

sq. pls.		
5	3481	(59 pls.
	25	
109	981	
	981	

∴ Boundary $= 4 \times 59$ pls. $= 236$ pls.

The question now is: 'If a man takes 1 hr. to go $7\frac{1}{2}$ miles, how long will he take to go 236 pls.?

$7\frac{1}{2}$ miles
8
60 furlongs
40
2400 poles

As 2400 pls. : 236 pls. :: 60 mins. : x

$$\therefore x = \frac{\overset{59}{\cancel{236}} \times \overset{1}{\cancel{60}}}{\underset{10}{\cancel{2400}}} = \tfrac{59}{10} = 5\tfrac{9}{10} \text{ minutes.}$$

∴ 5 mins. 54 secs. = Ans.

9. Two men own adjoining farms of 360 and 540 acres respectively. They unite the farms and take a partner who pays them £2,000, on the understanding that a third share of the land shall in future belong to each. How is the £2,000 to be divided between the original owners?

360 + 540 acres = 900 acres now belong to 3 men equally (*i.e.* 300 acres each).

Therefore one man loses 60 acres and the other 240 acres.

It is evident that the £2,000 is to be divided in the proportion 1 : 4.

i.e. one man has $\frac{1}{5} \times £2{,}000 = £400$
the other has $\frac{4}{5} \times £2{,}000 = £1{,}600$ } Ans.

10. The income tax was reduced from 7½ to 6d. in the £, but a man's gross receipts were at the same time reduced by 3⅛ per cent. Find by what percentage his net income is altered.

1st, say the man had £100 gross receipts.

I.T. of 7½d. in the $£ = \frac{15}{480} \times \frac{100}{1} = £\frac{25}{8} = £3\frac{1}{8}$,

∴ net income £96¼.

2nd, gross receipts of £100 − £3⅛ = £96⅞ gross receipts.

I.T. of 6d. in the $£ = \frac{775}{8} \times \frac{1}{40} = £\frac{155}{64} = £2\frac{27}{64}$,

∴ net income
£96 14/32
2 27/64
94 37/64

The sum now is, 'If the net income of £96¼ is altered by £2 27/64, what is that °/₀?'

£ £ °/₀
As 96¼ : 2 27/64 :: 100 : x

$$\therefore x = \frac{385}{4} \times \frac{155}{64} \times \frac{8}{775} = \frac{5}{2} = 2\tfrac{1}{2}\%$$ Ans.

11. A general having lost $\frac{3}{10}$ of his men in battle, and 7°/₀ of the remainder by sickness, found he had 18,414 left; how many had he at first?

$\frac{3}{10}$ lost in battle, ∴ $\frac{7}{10}$ remain.

But $\frac{7}{100}$ of $\frac{7}{10} = \frac{49}{1000}$ lost by sickness.

∴ $\frac{700}{1000} + \frac{49}{1000} = \frac{749}{1000}$ total loss.

∴ $\frac{251}{1000}$ remainder = 18,414.

∴ He had at first $\frac{18414 \times 1000}{251} = 73{,}400$ men. Ans.

12. In what time will £1,005 6s. 8d. amount to £1,156 2s. 8d. at 4°/₀ per annum simple interest?

£ s. d.
1,156 2 8 = A
1,005 6 8 = P
150 16 0 = I

Formula $t = \frac{100\,I}{P \times r} = \frac{100 \times 150\frac{4}{5}}{1005\frac{1}{3} \times 4}$

$$\therefore \text{Time} = \frac{385}{4} \times \frac{754}{5} \times \frac{3}{3016} = \frac{15}{4} = 3\tfrac{3}{4} \text{ years.}$$ Ans.

13. What will £6,510 8s. 4d. amount to in a year and a half, if put out at compound interest at 8°/₀ per annum, the interest being added at the end of each half year?

8°/₀ per annum = 4°/₀ for each half year.

£6510 8s. 4d. = $£6510\frac{8\frac{1}{3}}{20} = £6510\frac{1}{60}$ or $\frac{391}{6000}$.

(*a*) $£6510\frac{1}{60} \times 4\% = \frac{391}{6000} \times \frac{3125}{12} \times \frac{1}{25} = £1\tfrac{13}{48} = £1.$ for 1st half year.

$$\therefore \frac{78125 + 3125}{12} = \frac{81250}{12} = \text{Amt. for beginning 2nd hf. yr.}$$

(*b*) $\frac{81250}{12} \times \frac{1}{25} = \frac{3250}{12} = £1.$ for 2nd half year.

$$\therefore \frac{81250 + 3250}{12} = \frac{84500}{12} = \text{A. for begng. of 3rd hf. yr.}$$

(*c*) $\frac{84500}{12} \times \frac{1}{25} = \frac{3380}{12} = £1.$ for 3rd half year.

$$\therefore \frac{84500 + 3380}{12} = \frac{87880}{12} = \text{A. for end of 3rd half year.}$$

∴ £7323 6s. 8d. = Ans.

14. A trustee has £7,890 to invest; with £4,301 he buys stock at 93½, with the rest he buys stock at 97. How much stock will he hold from the two investments? (Neglect brokerage.)

£ £ stock
(*a*) As 93½ : 4301 :: 100 : x

$$\therefore x = \frac{100 \times 4301 \times 2}{187} = £4{,}600 \text{ stock.}$$

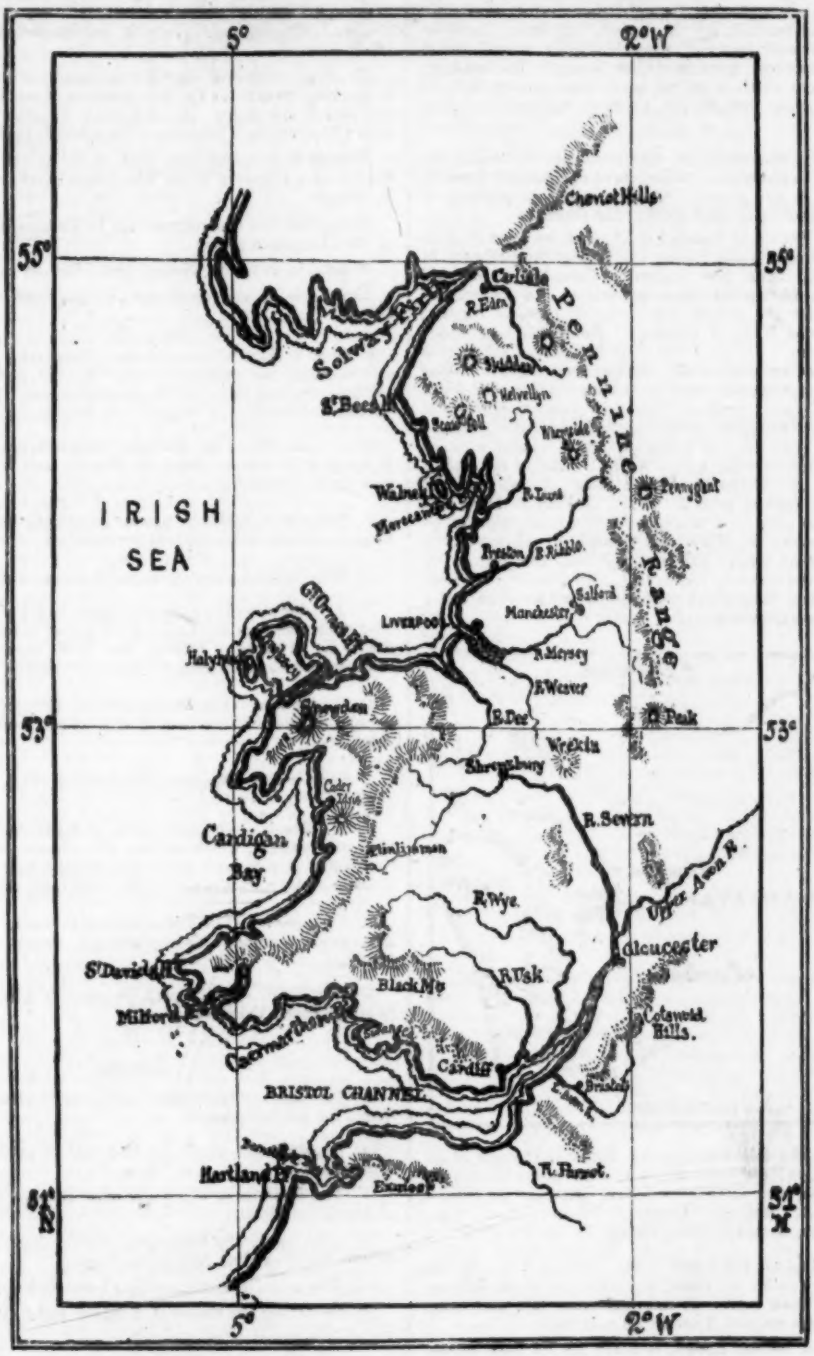
£ £ stock
(*b*) As 97 : 3589 :: 100 : x

$$\therefore x = \frac{100 \times 3589}{97} = £3{,}700 \text{ stock.}$$

∴ Total stock £4,600 + £3,700 = £8,300 stock. Ans.

Geography.

1. Draw an outline map, with lines of latitude and longitude, showing—(*a*) The coast from Solway firth to Hartland point, and the water-sheds which separate rivers flowing to this part of the coast from rivers flowing to other parts of the coast.



3. Give some account of the advantages of the position of London for (*a*) the capital of England; (*b*) a centre of international trade. By what railway routes could you travel (*a*) from London to Plymouth; (*b*) from London to Manchester? State briefly in what districts the nature of the country caused especial difficulty in the construction of the railways?

(*a*) It is situated near the sea, and is connected by rail, road, or canal, with every important town of the country. Its port is open all the year round, while its position on the Thames gives it easy communication across the country to the westward. (*b*) It is very near the land centre of the globe, while its climate permits of work all the year round. In a few hours travellers can journey from London to the Continent, and there is easy communication with Africa, America, Asia, and Australia.

(*a*) We travel by the Great Western Railway. During the construction of the latter, coal was very scarce in the east agricultural section, and many tunnels were cut through hills such as the Mendip Hills, and the Devonian Heights. The Severn Tunnel was opened for the South Wales section.

(*b*) *Either* by the L. & N.W.R. (Euston), by the branch line from Crewe to Leeds, passing through Manchester; *or* by the Midland R. (St. Pancras), by the branch line from Derby to Manchester. Many rivers and canals had to be crossed, and it was slow construction through 'Chat Moss.' The cuttings through the stone districts in the north were costly, while a famous tunnel exists through the Pennines between Yorkshire and Lancashire.

5. Name the governments of the territories by which the Russian Empire is bounded. Where have the Russian frontiers been advanced in late years? Mention towns or positions of military importance on or near the Russian frontiers.

The Russian Empire is bounded on the west by Prussia, with a limited government, under a king who is also the Emperor of Germany. The district now known as Poland is an integral part of Russia, and can scarcely be considered as a 'boundary.' Hungary is under the limited rule of the Emperor of Austria, who is also styled King of Hungary. Roumania is an independent monarchy. On the south there is a part of the empire under its absolute monarch, while the numerous Chinese states of E. Turkestan, Mongolia and Manchooria are under small obligations to China. South of Russia in Asia are Khiva and Bokhara tributary to Russia, but nominally under native rulers—Khan of Khiva and Emir of Bokhara. The Russian advance has been made towards the south—to the borders of our Indian Empire. After the Berlin Conference, 1878, Russia annexed Merv and cut a railway from E. of the Caspian to Merv and Samarkand, after they had subdued the Turcomen who barred the Russian advance by Herat and Candahar. However, the Khyber and Bolan passes are well fortified—the former by Peshawur, and the latter by Candahar. Still there is a loophole through the Gomul Pass, which ought to be well guarded, and a stand made before Ghuznee.

6. Where are the following towns? Show in the case of six of them, how their importance is due to their positions, or give other reasons for the interest which is attached to them—Dundee, Belfast, Armagh, Geneva, Venice, Buda-Pesth, Warsaw, Corinth, Bombay, Hong Kong.

(1) *Dundee* is on the north side of the Firth of Tay. It has been noted for years for its connection with the whale and sea fisheries of northern seas. It has important jute and hemp factories. Being a seaport, it carries on vast trade.

(2) *Belfast*, on Belfast Lough, is noted for its linen works. The flax is grown in the counties surrounding.

(3) *Geneva* is at the S.W. corner of the Lake of Geneva. Its importance was brought about by its favourable position with regard to the connections with other countries, and its delightful situation. Its chief industry is watch making.

(4) *Bombay* gained its pre-eminence through its position on an island off the west coast of India. It has a large and safe harbour, and is on the high road from England to India and China. It is the most important outlet of all Asia. It was ceded to Charles II. in 1661 by the King of Portugal, whose daughter he married.

(5) *Venice*, situated at the north of the Adriatic sea, to which position it formerly owed its fame. It is the city of canals and bridges. During late years it has manufactured lace and beads.

(6) *Hong Kong* is an island at the mouth of the Canton river. It has risen to note as the headquarters of our naval stations in this part of the globe. Its chief town, Victoria, has much trade with China, while it possesses a magnificent harbour.

Armagh is a county and town of N. Ireland (Ulster). The town is on a tributary of the Blackwater river, which flows into L. Neagh.

Buda-Pesth is a twin-city on the R. Danube, about the centre of the Hungarian plain.

Warsaw is on the R. Vistula, and is the old capital of Poland.

Corinth is on the south side of the Gulf of Lepanto, in Greece.

7. Give a short account of the climate and productions of, and mention the principal towns in, the district between—(*a*) The Maritime Alps and the Mediterranean; (*b*) The Eastern Ghauts and the Bay of Bengal; (*c*) The Andes and the Pacific.

(*a*) 1. *Climate.*—The 'Riviera' possesses an equable climate. It is cooled in summer by fresh breezes, and is sheltered from cold winds by the Alps.

2. *Productions.*—Olives, almonds, oranges, lemons, figs, mulberries, apricots and eucalypti are plentiful.

3. *Chief towns.*—Nice, Cannes, Mentone, and San Remo.

(*b*) 1. *Climate.*—The east coast plain is hotter than the west. The rainy season of the Coromandel Coast is brought about by the N.E. monsoon. During the S.W. monsoon (April to October) the Carnatic enjoys a pleasant climate.

2. *Productions.*—Timber abounds on the slopes. The most important products are rice, maize, wheat, opium, cotton and palms.

3. *Chief towns.*—Madras, Pondicherry (Fr.), Arcot, Carical (Fr.).

(*c*) 1. *Climate.*—The west coast of South America is washed by a cold current, which renders the climate equable. About the centre of this coast is the hot, rainless and sandy desert of Atacama, and in fact much of this west coast slope is barren.

2. *Productions.*—The slopes abound in wood. The chinchona tree yields quinine. Cocoa, tobacco, guano and silver are exported.

3. *Chief towns.*—Quito (port, Guayaquil). Lima (port, Callao). Santiago (port, Valparaiso).

History.

8. Give dates or approximate dates, and, when you can, give names for the following:—

(*a*) A statute to check the bestowal of estates on religious foundations.

(*b*) The Parliament which excluded Bishops from the House of Lords.

(*c*) A declaration by Parliament that the King's proclamations were to be as valid as Acts of Parliament.

(*d*) The union in matters of law between England and Wales.

(*e*) An Act for the Union of England and Scotland.

(*f*) The defeat of the Spanish Armada.

(*g*) An Act to prevent prisoners being kept long in gaol without trial.

(*h*) A declaration suspending penal statutes against Roman Catholics and Dissenters.

(*i*) A company which in effect offered to pay off the National Debt.

(*k*) A treaty which gave to England the right of trading in slaves, and the possession of Gibraltar and Newfoundland.

(*l*) A treaty which gave Canada to England.

(*m*) An Act admitting Roman Catholics to Parliament.

(*a*) 1279.—Statute of Mortmain.
(*b*) 1641.—Long Parliament, which passed 'Root and Branch Bill.'
(*c*) 1539.—During reign of Henry VIII.
(*d*) 1536.—Incorporation of Wales.
(*e*) 1707.—Act or Treaty of Union.
(*f*) 1588.—Armada defeated.
(*g*) 1679.—Habeas Corpus Act.
(*h*) 1687.—Declaration of Indulgence.
(*i*) 1720.—South Sea Company.
(*k*) 1713.—Treaty of Utrecht.
(*l*) 1763.—Treaty of Paris.
(*m*) 1829.—Catholic Emancipation Bill.

10. Describe the relations between Rome and the British Isles in the time of two of the following:—Agricola, William the Conqueror, King John, Henry VIII.

King John, on the death of Hubert the Primate, 1205, wished to elect John de Grey to the office, but Pope Innocent said that John had elected the Bishop of Norwich while the see was not vacant. The Pope ordered Stephen Langton to take the place, but John said that Langton should never set foot in England. Innocent placed the kingdom under an interdict in 1208, which was followed by an excommunication bill, 1209, and finally the Pope deposed John, 1212. Philip of France, encouraged by the Pope, began to prepare to invade England, but John did not give in, for he actually scorned the Roman legate, Pandulf. John raised an army, and stirred up enemies against France; but the king soon found that conspiracies were afloat among his barons, and John rushed to the feet of Rome to beg forgiveness, and he offered his kingdom as the Pope's vassal.

Henry VIII., through the aid of Thomas Cromwell, brought about the final severance from Rome. In 1534 the Parliament passed the 'Act of Supremacy'—the English king should be the supreme head of the English Church; the Papal power in England should be destroyed, and all payments to Rome abolished. Henry VIII. was perhaps more eager to bring about this change owing to his hatred of the Pope, who was not agreeable to his divorce from Catherine. In fact, this Reformation in England was of a political rather than of an ecclesiastical nature. The election of bishops was left to the chapters, who had to elect the candidate of the king's liking.

11. Give a short biography of Edward I., *or* of William III. Show the great objects which he sought to attain, and estimate his success.

Edward I. was the son of Henry III., and at his father's death in 1272 he succeeded to the throne. His first object was to settle the Welsh troubles. This subjection was brought about after two small wars, in the second of which Llewellyn was slain by Frangton, at Builth, 1282. He introduced English law into Wales, 1284. He now concentrated his attention on the settlement and good government of England by completing the judicial reforms of Henry II. The three common law courts now received judges of their own, who were able men, and were well looked after by the 'English Justinian.' The origin of the common modern jury dates from this period. He brought about the 'Statute of Mortmain,' 1279, to prevent the alienation of land to the Church so as to escape feudal service. He cared for traders, as is seen in his 'Statute for Merchants.' In 1285 he improved the police regulations and national defence by his 'Statute of Winchester.' Conservators of the peace (now justices of the peace) were elected to see that the latter Act was carried out. In 1295 he summoned to the Parliament representatives of the lower clergy, and about the same time he admitted burgesses and knights of the shire. He aimed at lessening the power of the barons by raising the whole of the landowners to the same level, ordering all who owned land of £20 annual value to receive knighthood. Edward I. meant to keep Scotland as his vassal, and so he awarded the kingdom, after the death of Alexander III., to the eldest claimant, John Balliol. However, the latter revolted from his vassalage, and after Edward I. defeated him at Berwick (1296) and again at Dunbar (1296), he retired to Normandy. Wallace now fought for the independence of Scotland, but in 1304 the country was regarded as a conquered State. Bruce soon headed the Scottish rebels, and their successes caused Edward some anxiety; so much so that he resolved to make another campaign against them, when death stayed his pursuit at Burgh-upon-Sands, 1307.

13. Mention, with dates if you can, risings in the times of the Tudors which were due to discontent caused by religious changes, taxation, or poverty. Give a short account of one of these risings. Mention (*a*) causes which in that period produced distress and vagrancy; (*b*) any measures taken to meet these evils.

1497.—Popular insurrection in Cornwall through Henry VII. demanding a subsidy for Scottish War.

1536.—Risings owing to religious changes—closing of monasteries.

1549.—Risings in Cornwall and Devon caused by changes in religion.

1549.—Risings in Norfolk caused by the enclosing of common land.

1554.—Wyatt's insurrection through religious hatred.

1569.—Rebellion in the North in favour of Mary and the old religion.

Ket's insurrection, 1549.—The men of Norfolk demanded the removal of evil counsellors, and the restoration of public lands.

(*a*) This rebellion was brought about by (1) The decline of feudalism, which threw much free labour on the markets. (2) There was a less demand for labour, as the landlords had thrown the land into sheep walks to meet the increasing want of wool. (3) The tillage of the land did not pay under the new conditions. (4) Food was at a very high price. (5) In pursuit of (2), public commons had been enclosed. (6) The suppression of the religious houses caused many to be out of employment or of support.

(*b*) (1) Severe vagrant laws were put in force. (2) Lord-Lieutenants were appointed with authority to levy men to fight for the king.

The national rising in Norfolk was at first successful, but the Earl of Warwick defeated the insurgents, and Ket was executed with many of the other leaders.

14. State of each of the following (*a*) when he lived, (*b*) for what his name is well-known—Adam Smith, James Watt, Arkwright, Thomas Cromwell, Frobisher, Cabot.

Adam Smith was living during the reign of George III. He was the founder of the School of the Science of Political Economy. He wrote 'The Wealth of Nations,' from which many of our statesmen have obtained valuable information. Smith also studied moral philosophy.

James Watt lived during George III.'s reign. He discovered the wonderful uses to which steam could be put.

Arkwright was a barber who invented the spinning machine in 1768.

Thomas Cromwell was the willing instrument of Henry VIII. The Reformation in England was mainly brought about by him. Cromwell was appointed Vicar-General, and it was left to him to destroy the smaller monasteries. He claimed the right of the king to choose the national doctrines. Cromwell's cruelty was well displayed in the 'Pilgrimage of Grace.' He introduced Anne of Cleves to Henry, and through the king's dislike of her, added to the baron's enmity with Cromwell, the strong-willed man lost power, and was actually executed for high treason in 1540.

Frobisher (Martin) was contemporary with Elizabeth. He proposed a journey to Asia by the N. coast of America, but he found his way to Labrador. He played an important part during the invasion of the Armada, 1588.

Cabot (Sebastian) was living at the time of Henry VII. He was a great explorer, and he discovered Labrador, Newfoundland, and the coast of N. America, 1497.

French.

1. Translate into English—

(*a.*) Hélas! lui répondit son père en versant des larmes, crois-tu, pauvre enfant, que *l'on puisse parler* à l'empereur comme tu parles à ton père en Sibérie? Des sentinelles gardent de toutes parts les avenues de son palais, et tu ne pourras jamais *en passer* le seuil. Pauvre et mendiante, sans habit, sans recommandations, comment oseras-tu paraître, et qui daignera te présenter?

(*b.*) Pendant un de ces violents orages qui sont très fréquents dans ces contrées, les bateliers, voulant éloigner la barque du rivage, poussèrent avec force une grande rame, *qui servait de*

gouvernail, du côté où plusieurs personnes étaient assises sur le bord du bateau, et n'eurent plus le temps de la retirer ; trois passagers, au nombre desquels étaient Prascovie, *furent renversés* dans le fleuve.

(*a.*) Alas! replied her father, shedding tears, do you believe, poor girl, that people can talk to the emperor as you talk to your father in Siberia? Sentinels guard on all sides the avenues of his palace, and you will never be able to pass over its threshold. Poor and beggarly, without clothes, without recommendations, how will you dare to appear, and who will condescend o present you?

(*b.*) During one of these violent storms, which are very frequent in these countries, the boatmen, wishing to remove the boat from the shore, strongly pulled a large oar, which used to serve as a rudder, on the side where several persons were seated at the edge of the boat, and there was no time to withdraw it ; three passengers, among whom was Prascovie, were overturned nto the river.

2. Parse the words printed *in italics* :—

L'on = *Pron.*, indef., sing. num., 3rd pers., masc. gen., nomin. case to '*puisse parler.*'

puisse = *Verb*, irreg. (pouvoir, pouvant, pu je peux (or puis), je pus), intrans., 3rd conj., pres. tense, subj. mood, sing. num., 3rd pers., agreeing with its nom. '*L'on.*'

parler = Present, active, infinitive of the regular verb (parler, parlant, parlé, je parle, je parlai), 1st conj., governed by '*puisse.*'

en = *Pron.*, conj,, sing. num., 3rd pers., masc. gen., genitive case.

passer = Present, active, infinitive of the regular transitive verb (passer, passant, passé, je passe, je passai), 1st conj., governed by '*pourras.*'

qui = *Pron.*, relat., sing., 3rd pers., femin. gen. (antecedent is '*rame*'), nomin. case to '*servait.*'

servait = *Verb*, regular (servir, servant, servi, je sers, je servis), intrans. indic. mood, past imperf. tense, 2nd conj., sing. num., 3rd pers., agreeing with its nom. '*qui.*'

de = *Prepos.*, governing '*gouvernail.*'

gouvernail = *Noun*, com., sing. num., 3rd pers., mas. gen., genit. case after prep. '*de.*'

furent = *Verb*, auxiliary, used to form passive voice. Past def. tense, indic. mood of the verb être (étant, été, je suis, je fus.)

renversés = Perfect passive participle of '*renverser.*' Plural, mas., to agree with '*passagers.*'

furent renversés } = *Verb*, regular (renverser, renversant, renversé, je renverse, je renversai), trans. indic. mood, past def. tense, passive voice, plur. num., 3rd pers., agreeing with its nom. '*passagers.*'

3. Write in French :—I am very fond of reading. I see him every day. Which of these coats is yours? In what year were you born? They did not give these books to you.

J'aime très bien à lire. Je le vois tous les jours. Lequel de ces habits est le tien? En quel an naquites-vous? Ils ne vous donnèrent pas ces livres.

4. Put in the singular number :—Ses petits pieds blancs. Leurs drapeaux tricolores. And into the plural number :—Le cheval de l'ecuyer. L'hôte du paysan.

(*a.*) Son petit pied blanc. Leur drapeau tricolore.

(*b.*) Les chevaux des ecuyers. Les hôtes des paysans.

5. Write out in words (*a*) the numerals from 1 to 30, (*b*) the names of the months and of the days of the week, and (*c*) the present and perfect tenses of être, porter, recevoir and pouvoir.

(*a*) *Numerals.* Un, deux, trois, quatre, cinq, six, sept, huit, neuf, dix, onze, douze, treize, quatorze, quinze, seize, dix-sept, dix-huit, dix-neuf, vingt, vingt et un, vingt-deux, vingt-trois, vingt-quatre, vingt-cinq, vingt-six, vingt-sept, vingt-huit, vingt-neuf, trente.

(*b*) *Months.* Janvier, février, mars, avril, mai, juin, juillet, août, septembre, octobre, novembre, decembre.

Days of week. Dimanche, lundi, mardi, mercredi, jeudi, vendredi, samedi.

(*c*)

	Present tenses.	*Perfect tenses.*
1. être	je suis	j'ai été
	tu es	tu as ,,
	il (elle) est	il (elle) a ,,
	nous sommes	nous avons ,,
	vous êtes	vous avez ,,
	ils (elles) sont	ils (elles) ont ,,
2. porter	je porte	j'ai porté
	tu portes	tu as ,,
	il (elle) porte	il (elle) a ,,
	nous portons	nous avons ,,
	vous portez	vous avez ,,
	ils (elles) portent	ils (elles) ont ,,
3. recevoir	je reçois	j'ai reçu
	tu reçois	tu as ,,
	il (elle) reçoit	il (elle) a ,,
	nous recevons	nous avons ,,
	vous recevez	vous avez ,,
	ils reçoivent	ils (elles) ont ,,
4. pouvoir	je peux (je puis*)	j'ai été pu
	tu peux	tu as ,,
	il (elle) peut	il (elle) a ,,
	nous pouvons	nous avons ,,
	vous pouvez	vous avez ,,
	ils (elles) peuvent	ils (elles) ont ,,

* Puis is the form used in the interrogative conjugation (for the 1st person). Puis-je? Can I?

Penmanship.

Victoria Nyanza.

An honest tale speeds best,
being plainly told.

School Management.

1. Write full Notes of a Lesson on *one* of these subjects :—(1) The Exploration of Africa. (2) The Analysis of a Sentence. (3) (*For Infants*) A Flower Garden.

(2) *The Analysis of a Sentence.* Standard IV. Time 45 minutes. Apparatus : Blackboard, &c., ruled for Analysis. Slates and pencils.

MATTER.	METHOD.
Introduction.—'A sentence is a complete thought expressed in words.'	Recapitulate the former lesson on a 'Sentence.' Now write on blackboard '*The boy caught a bird yesterday.*'
Ideas Developed.—A sentence contains :	
(*a*) Some word (or words) which states something about some person or thing.	(*a*) Let the boys tell which word (or words) in the sentence states something about a person or thing. Tell children that it is best to find this part of a sentence first. Ask what part of speech '*caught*' is.
(*b*) The person or thing about something which is said.	(*b*) Ask what is the word which 'caught' says something about. (The boy.) Show that this may be found by saying 'Who (or what) caught ?' The class can now see what part of speech this part of a sentence generally is. The teacher should take advantage of the children's former knowledge (Standard III.) by connecting analysis with parsing. Thus—

NOUN-WORD.	VERB-WORD.
The boy	caught

(*c*) Some word (or words) which completes the thought or sentence.	(*c*) Some one might ask *what* the boy caught ? or *whom* the boy caught ? Children will see that 'The boy caught ——' cannot form a complete sentence. Now when 'a bird' is added to 'The boy caught,' a complete sentence is formed—'The boy caught a bird.'
(*d*) The sentence may be extended or modified as regards the manner, time, or place of the action or being.	(*d*) Show that the addition of 'yesterday' does not complete the sentence (which has already been shown to be complete), but it only extends the sentence. These extensions may be found by asking how ? when ? where ? after the sentence. These definitions and names should be committed to memory, and the children should be required to produce them on their slates.
Names Given and Definitions.	
(*a*) The word (or words) which states something about some person or thing forms the *Predicate.*	*Matter and Method.*—The children can now be shown that 'the subject of a sentence is always in the nominative case to its predicate, *i.e.*, the noun or pronoun in the subject is always nominative to the verb in the predicate. The noun or pronoun is therefore in the nominative case when it answers the question who ? or what ?
(*b*) The person or thing about which something is said forms the *Subject.*	
(*c*) The word (or words) which completes the thought is called the *Object.*	
(*d*) The word (or words) which extends the thought forms the *Extension of the Predicate.*	

Exercises.—Similar sentences might now be written on the board, and the children should be required to write out the parts of the sentences. They should also be required to form sentences of their own.

3. Mention any twelve words, the spelling of which presents special difficulty to young learners ; and say by what sort of exercises you can best help such learners to spell them correctly.

(1) *There.*—When spelling 'there' follow it by its meaning 'in that place.' Cf. where, here, ere. Contrast their, heir.

(2) *Their.*—After spelling 'their,' follow it by its meaning 'belonging to them.' Cf. heir. Contrast with where, here, ere.

(3) *Which, what, &c.*—Tell the children that these words were once written hwich, hwat, &c., and therefore it is right to sound the 'h' first now.

(4) *Loving, Moving, &c.*—When spelling these words, say 'lov(love)-ing.' Repeat rule, 'When a word ends in "e," and "-ing" is added, the "e" is left out. Contrast dyeing, singeing. Show why the 'e' is kept in these cases.

(5) *Bough.*—Cf. with cow, now, vow, &c. Contrast rough, tough, cough. Refer to peculiar pronunciation of hough, hiccough.

(6) *Piece.*—Follow the spelling by meaning 'a part.' (Pleasant to note *piece* of *pie.*) Cf. niece. Contrast peace (quietness).

(7) *Caught.* (8) *Taught.* (9) *Bought.* (10) *Brought.* (11) *Fought.* (12) *Sought.*—These six words are a constant cause of confusion to young learners, so it would be well to resort to some *aid to memory.* Great interest will be evinced in the forming of little sentences containing these words. Teacher takes first one : 'He *caught* a mouse.' Then children are asked what should be said if a mouse is likely to be caught to-morrow. We cannot write 'He will *caught* a mouse to-morrow.' Thus 'catch' may be elicited. Similarly obtain : teach, buy, bring, fight, seek. *Now arrange them thus—*

catch : caught teach : taught	'*a*'
buy : bought bring : brought fight : fought seek : sought	'*o*'

A card containing these words should appear on the school-wall for constant reference. Children will soon note '*a*' *occurs in both parts of the word.*

6. It is said that 'in teaching we should proceed from the known to the unknown.' Explain what this means, and show how it is applicable to a lesson on either geography or grammar.

It is one of the fundamental rules of teaching, 'That we should proceed from simple things of every-day life, and by careful questioning lead the learners to grasp something which was indistinct to them before, but which, by the teacher's aid, they have arrived at themselves.'

Example.—In teaching 'Plan of a School,' some begin directly with the plan. This, however, should be the method :—(*a*) First take a pencil box, and make the plan of it on the blackboard, which has been placed on the ground. (*b*) Show that it is not always convenient to place the board on the floor. Now take small articles within the room, and draw the plans on the floor and then on blackboard. (*c*) Attention may now be turned to the shape of the room, and a rough outline should be chalked on the floor (windows may be left for a time). (*d*) The same plan may now be drawn roughly on the blackboard, the teacher being careful not to draw it always the same size, so that the boys become acquainted with the proportion of all on the ground plan. Objects should now and then be misplaced, or their size exaggerated, so as to familiarise the children with the right position and size of all on the plan. (*f*) Rough plans may now be drawn by the children, and finally a plan to scale on blackboard, the larger measurements taken by counting steps, and small objects by actual measurement. Children have been led from the known to the unknown.

7. Give a list of the maps, pictures, diagrams and apparatus which you think ought to be provided in a well-furnished school-room.

Maps.—(*a*) Coloured maps of all countries studied in geography. (*b*) Historical maps for history lessons (plans of battle-fields). (*c*) Blank maps for recapitulatory purposes. (*d*) Maps in relief to illustrate geographical terms.

Pictures.—To illustrate scripture, geography, history, and science lessons. Some relating to : 'The dress and manners of olden times ;' 'Objects of every-day life ;' 'Common animals, birds, fishes, insects, trees, plants, fruits ;' 'Common manufactures ;' 'Great men and women ;' 'Great battles (on land and sea).'

Diagrams.—For use in arithmetic, geography, science and needlework lessons. For example :—'Multiplication and division of fractions' should be illustrated with 'square measure,' &c. Plans of school and neighbourhood.

Apparatus required.—Blackboards (one for teaching solid geometry), blackboard cleaners, easels, chalk, slates, frame for ruling slates, pencils, reading sheets and books, copy books, coins, weights, measures, globes, models, school museum, school library, object stand.

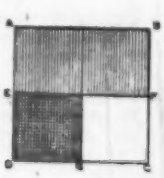
9. What are the advantages and disadvantages of simultaneous reading, and when and how should the practice be adopted ?

Advantages.—1. The whole class gets ample practice. 2. It aids hesitating children. 3. It is a stimulus to the slow, and a check on the quick readers. 4. It is a powerful method of teaching expression and intonation. 5. Faults common to the whole class may be corrected by this method.

Disadvantages.—1. Artificial reading may follow, unless there be plenty of individual reading. 2. It is impossible to correct individual faults. 3. The teacher cannot be sure that the child sees every word he says. 4. Any omission in the correction of faults causes the error to be intensified by its constant repetition. *Simultaneous reading* should not be resorted to until the teacher feels satisfied that all the children can follow the words (*i.e.*, can keep their eyes before their ears). The teacher should read a sentence with a slightly exaggerated emphasis, then children should follow. Some might repeat from memory, but they should be told to read backwards.

10. Show by what sort of visible objects and illustrations you could make the rule for the addition of fractions intelligible to a class of beginners.

Say that you start with $\frac{1}{2}+\frac{1}{4}=\frac{3}{4}$. (1) Take an apple or orange and divide into two equal parts. Now divide each of these halves into two equal parts. Children will now see that the whole has been divided into four equal parts. That two such parts form one half. $\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4}$. Q. E. D.



(2) Take a square and divide it into four equal parts. Class can see that AF = $\frac{1}{2}$ square and EG = $\frac{1}{4}$ sq. and AF = $\frac{1}{2}$ sq. or $\frac{2}{4}$ sq.
∴ AF + EG = $\frac{2}{4}$ or $\frac{3}{4}$ + $\frac{1}{4}$ = $\frac{3}{4}$. Q. E. D.

(3) Refer to the parts of a penny. $\frac{1}{2}$d. = 2 farthings or $\frac{2}{4}$d.
∴ $\frac{1}{2}$d. + $\frac{1}{4}$d. = $\frac{2}{4}$d. + $\frac{1}{4}$d. = $\frac{3}{4}$d. Q. E. D.

11. It is sometimes said that one of the best ways of teaching history is by means of biography. Explain this. Name five or six persons whose biography would throw great light on the history of the eighteenth century, and give a slight sketch of *one* such biography.

One of the best ways to teach history is to begin with the history of persons, and from thence the children will be able to remember many facts. Besides, more interest will be taken in the lessons when the boys know that the men they are learning about were men of like passions with other men. Thus the teacher can show how their particular characters suited the times and events, how they fought boldly until their ends were fully obtained. It awakens patriotism and a love of virtue by exciting suitable emotions. Thus a child might get a good knowledge of the eighteenth century by studying the lives of the Duke of Marlborough, Sir Robert Walpole, Lord Clive, Earl of Chatham, Washington, and John Wesley.

LORD CLIVE was born in Shropshire, 1725. He cared little for education in his early days, and his father sent him to India, as a clerk in the East India Company's service. He was disgusted with the latter, and in 1747 joins the Army in India. He soon distinguishes himself, and obtains the rank of commissary-general. It was now that the French thought they ought to possess India, and Dupleix, their general, for some time carried all before him, until Clive's genius suggests an immediate attack on Arcot, which ended successfully. Clive now came to England for a short time, but in 1755 he returned to India as governor of Fort St. David. However, in 1756, Surajah Dowlah seized Calcutta, and confined 146 persons in a dungeon, called afterwards 'The Black Hole of Calcutta.' Clive recaptured Calcutta, and gained the battle of Plassey, 1757, after which our Indian Empire gradually increased. Clive was for a few years president of Bengal. In 1773 a motion was made in the House of Commons to resolve that 'in acquiring his wealth Lord Clive had abused the power with which he had been intrusted.' He defended himself with such spirit and modesty that the motion was not only rejected but the House agreed that he had rendered valuable services to his country. The ungrateful treatment penetrated his soul, and he soon afterwards committed suicide (1774).

13. Give some examples of exercises in mental arithmetic suitable for the highest class in a school, and show by what means rapidity and accuracy can be best secured in conducting such exercises.

Mental arithmetic should form an important lesson in the upper classes, as it is to be remembered that most of the calculations in after days will be mental.

(1) Special attention should be given to 'tots.' It is a good plan to place the sum on the blackboard before the class and expect the children to find the answer without writing anything down. This must concentrate their attention.

(2) Many sums of every-day occurrence should be given. N.B.—5 per cent. = 1s. in the £ ; 2½ per cent. = 6d. in the £. Thus £190 at 5 per cent. = 190s. = £9 10s.

(3) The sums relating to wages should be practised. They must commit to memory 1d. per day is 30s. 5d. per year, and so calculate 2d., 3d., &c., per day.

(4) They should be taught the divisibility of numbers, so that they could tell mentally what number will exactly divide another. *Example :* Is 7,632 divisible by 9? Yes, because the sum of the digits is divisible by 9.

(5) A dozen articles at 6½d. each. Call the pence shillings, and take ½ of a shilling (12d.) and call it pence (6d.) Ans. ∴ = 6s. 6d.

(6) To find the squares of ordinary numbers mentally. *Example :* Find square of 25. Work by formula $(a + b)^2 = a^2 + 2ab + b^2$.

$$\begin{cases} 25^2 = (20 + 5)^2 = 20^2 + 2.20.5 + 5^2 \\ \quad\quad\quad\quad\quad\quad = 400 + 200 + 25 \\ \quad\quad\quad\quad\quad\quad = \underline{625}. \text{ Ans.} \end{cases}$$

(7) Show the difference between decimal and vulgar fractions.

(8) Deal with proportion and percentages through fractions.

Music.

1. Re-write the following :—(1) doubling the value of every note and rest, and (2) again, halving the value of every note and rest.

| m .f :s | : .d | f :- .s | m :- ‖

(1) Double Value.

| m :f | s :- | : | :d }
| f :- | — :s | m :- | — :- ‖

(2) Half Value.

| m,f .s : .,d | f .,s :m ‖

2. Describe the intervals (major third, &c.) formed by the following pairs of notes :—

(1) m — t = Major (or Perfect) Fifth.
(2) se — f¹ = Diminished Seventh.
(3) r — t = Major Sixth.
(4) se — d¹ = Diminished Fourth.

4. Write the pulse signs—

(1) For two-pulse measure. (1) | : ‖
(2) For three-pulse measure. (2) | : : ‖
(3) For four-pulse measure. (3) | : | : ‖
(4) For six-pulse measure. (4) | : : | : : ‖

5. Write a descending minor scale (*lah* mode), using the minor or occasional seventh, and the minor or essential sixth.

l s f m r d t, l,
= minor sixth.
= minor seventh.

Dictation.

Whatever I have tried to do in life, I have tried with all my heart to do well; whatever I have devoted myself to, I have devoted myself to completely; in great aims and in small I have always been thoroughly in earnest. I have never believed it possible that any natural or improved ability can claim immunity from the companionship of the steady, plain, hard-working qualities, or can hope to gain its end without them. There is no such thing as such fulfilment on this earth. Some happy talent and some fortunate opportunity may form the two sides of the ladder on which some men mount, but the rounds of that ladder must be made of stuff to stand wear and tear; and there is no substitute for thorough-going, ardent and sincere earnestness. Never to put one hand to anything on which I could throw my whole self; and never to affect depreciation of my work whatever it was, I find now to have been my golden rules.

Mensuration.

10. The sides of a triangle are in the ratio of 13, 13, and 10; if its area be 3,840 sq. yards, find the length of each side.

Perpendicular height $= \sqrt{13^2 - 5^2} = \sqrt{169 - 25} = 12$.
Now let x be the number of times greater than given sides.
Then area of a $\triangle$ = base $\times$ $\angle$'r height $\div$ 2.

By substitution $3840 = \frac{10x \times 12x}{2} = 60x^2$

$\therefore x^2 = 64$ and $x = 8$.

Consequently the sides are 104, 104, and 80. Ans.

11. The diameters of the wheels of a bicycle are 48 and 14 inches respectively.; find how many more revolutions the small wheel will make than the large wheel in a distance of 10 miles ($\pi = \frac{22}{7}$).

10 miles = 17,600 yds. = 52,800 ft. = 633,600 inches.
⊙ence of a ⊙ = $2\pi r$

Then ,, large wheel $= \frac{48 \times 22}{7}$

,, ,, small ,, $= \frac{14 \times 22}{7}$

Therefore revolutions of large wheel $= \frac{633600 \times 7}{48 \times 22} = 4200$

,, ,, small ,, $= \frac{633600 \times 7}{14 \times 22} = 14400$

,, small wheel goes 10,200 more revolutions = Ans.

Grammar and Composition.

COMPOSITION.

Write a short essay on *one* of these subjects :—

(*a*) Some uses of the Electric Telegraph, (*b*) A Court of Justice, (*c*) Emigration.

(*a*) *Some uses of the Electric Telegraph.*—

Among the many inventions of the last fifty years, that of the electric telegraph is almost unsurpassed in utility. What a great boon it is to commercial men! The person who wishes to invest money in foreign stocks can soon find out the safety as well as the real value to be put on such an investment. The merchant can ascertain the worth of any commodity in any part of the world, and is thus enabled to purchase his goods from the cheapest market.

The benefits of the telegraph in every-day life are still more numerous. What a collapse the newspapers would have, were this swift messenger to fail! This instrument of communication is also extensively used by political clubs, as well as by all kinds of sportsmen. How many prisoners have been prevented from escaping from the hands of justice simply through telegraphing to all police authorities! Thousands of remarkable actions have happened, and as many unfortunate occurrences have happily been settled through its timely word.

What would Wellington or Nelson have given for this wonderful mechanism! Its aid, as an implement of warfare, can hardly yet be said to have been tested. The commanding officer may know from his distant comrades the latest movements of the enemy, and he may accelerate or retard the encounter accordingly. Assistance can shortly be sent to any spot, weak through an oversight, or through a sudden attack.

Finally the electric telegraph is of great use in naval engagements, which has been amply proved by the recent manœuvres of our fleet. Cruisers have espied the enemy, communicated the latter's whereabouts to their own squadron, who have sent ships in pursuit, and have silently entrapped the whole of the opposing forces.

GRAMMAR.

1. Paraphrase this passage :—

'Ah! what avail the largest gifts of Heaven
When drooping health and spirits go amiss?
How tasteless then whatever can be given!
Health is the vital principle of bliss;
And exercise, of health. In proof of this
Behold the wretch who wastes his life away,
Soon swallowed in disease's sad abyss;
While he whom toil has braced, or manly play,
Has light as air each limb, each thought as clear as day.'

THOMSON.

The bests gifts of God are useless unless accompanied by sound health and cheerful spirits. A sickly mind and body can furnish no keen appetite for the joys of this life, for a healthy taste is the product of a sound body, which is only to be maintained by exercise. The poor creature who dissipates his health and substance in the pursuit of vice quickly falls a victim to serious ill health; whereas the man who has strengthened his body with manual labour or vigorous sport, has the springiness of perfect health with the luxury of a clear head.

2. Parse this sentence :—

'Even now where Alpine solitudes ascend
I sit me down a pensive hour to spend.'

WORD.	ACCIDENCE.	SYNTAX.
Even	*Adverb* expressing equality or sameness of time, hence used to express *emphasis*; 'even now' meaning 'at this very moment' (A.S. efen).	modifying '*now*.'
now	*Adverb* of time (A.S. nû).	modifying '*ascend*.'
where	*Conjunctive Adverb* (A.S. hwær).	joining '*I sit me down*,' &c., with '*Alpine solitudes*,' &c.
Alpine	*Adject.*, Proper, of quality (cog. L. albus, white).	qualifying '*solitudes*.'
solitudes	*Noun*, com. abst., plur. num. 3rd pers., neut. gen. (L. solitudo, solus = alone).	nom. case to '*ascend*.'
ascend	*Verb*, finite, weak (-ed,-ed), Trans. (used intransitively here), indic. mood, act. voice, pres. tense, 3rd pers., plur. num. (L. ad and scando, I climb).	agreeing with its nom. '*solitudes*.'
I	*Pronoun*, pers., sing. num, 1st pers., com. gen. (A.S. ic, ich, ik).	nom. case to '*sit*.'
sit	*Verb*, finite, strong, (sat, sat), reflect., indic. mood, pres. tense, 1st pers, sing. num. (A.S. sittan, to sit).	agreeing with its nom. '*I*.'
me	*Pronoun*, reflect., sing. num., 1st pers., com. gen. (A.S. me).	objective case after reflective verb '*sit*.'
down	*Adverb* of place (Icel. dun).	modifying '*sit*.'
a	*Adjec.* (sometimes called the indefinite article), (A. S. an, on).	limiting '*hour*.'
pensive	*Adjec.* of quality, regularly compared by more and most (Fr. penser, to think).	qualifying '*hour*' attributively.
hour	*Noun*, com. abst., sing. num., 3rd pers., neut. gen. (Fr. heure).	objective case after '*to spend*.'
to spend	*Verb*, infinite, weak (spent, spent), trans., pres., active, infin. mood (L. ex and pendo).	dependent on '*sit*' and governing '*hour*.'

3. Analyse the following passage :—

'As in a theatre, the eyes of men,
After a well-graced actor leaves the stage,
Are idly bent on him that enters next,
Thinking his prattle to be tedious;
Even so, or with much more contempt, men's eyes
Did scowl on Richard: no man cried, "God save him!"
No joyful tongue gave him his welcome home.'

Sentences I., II. and III. form a *Complex* Sentence.

Principal Sentence II., 'The eyes of men are idly bent [*as in a theatre, after a well-graced actor leaves the stage* (a Subordinate Adverbial Sentence of time)] on him [*that enters next* (a Subordinate Adjectival Sentence)], thinking his prattle to be tedious.'

SENTENCE.	NATURE.	RELATIVE TO PRIN.	SUBJ.	ENLARGEMENT.	PREDICATE.	EXTENSION.	OBJECT.	ENLARGEMENT.
1. As in a theatre, after a well-graced actor leaves the stage	Subord. Adverbl. of manner to 2	modifying 'are bent'	(after) actor	a well-graced (adject.)	leaves	as in a theatre (manner)	the stage	
2. The eyes of men are idly bent on him (sent. 3), thinking his prattle to be tedious	Prin. Sent. to 1 and 3	...	the eyes	of men (genit.) thinking his prattle to be tedious (participial enlarg. of men)	are bent	1. idly (manner) 2. on him (place) that enters next (attribute of him) 3. Sent. 1 (manner)		
3. that enters next	Subord. Adject. to 2	qualifying 'him'	that	...	enters	next (order)		
4. Even so, or with much more contempt, men's eyes did scowl on Richard	Simple Sentence correlative with 1	...	eyes	men's (possessive)	did scowl	on Richard (place), even so, or..... contempt (degree)		
5. no man cried	Simple S. co-ordinate with 7	...	man	no (demons.)	cried			
6. 'God save him!'	Simple S. (Mason)	...	God	...	save	...	him	
7. No joyful tongue gave him his welcome home	Simple S. co-ordinate with 5	...	tongue	no joyful (adjec.)	gave	...	home (dir.) him (to) (indir.)	his welcome (adj.)

4. Select from the two extracts given in questions 1 and 3 any words which you know to be of Latin origin, and give the root of any six of them, with examples of other words having the same derivation. Choose also six purely English words, and say how you recognise them.

Latin words from the two extracts. (1) Avail, largest, spirits, amiss, vital, principle, exercise, proof, disease's, braced, clear. (3) Graced, actor, stage, enters, tedious, contempt, save.

Six Latin words:—

(*a*) *avail*, from L. ad. (to) and valeo (I am strong) — valid, prevail.
(*b*) *spirits*, from L. spiritus (breath) — respiration, conspire.
(*c*) *vital*, from L. vitalis from vita (life) — vitality.
(*d*) *clear* ,, L. clarus (bright) — clarify.
(*e*) *graced* ,, L. gratia (favour) — gratify, grateful.
(*f*) *contempt* from L. con (with) and temno (I despise) — contemn.

Six English words:—

(*a*) *what*. All words beginning with 'wh' are English. These were formerly written hw:—what=A.S. hwæt.

(*b*) *then*. Most monosyllables are English words. Again, almost all adverbs of time are of Anglo-Saxon origin.

(*c*) *can* is a monosyllabic word. Besides, all defective verbs are English. It is from the old A.-S. verb cunnan (to know).

(*d*) *thought*. All words containing 'gh' are English, with the exception of the mis spelt word 'delight,' which Chaucer always writes 'delyte.'

(*e*) *next* is an English word, which is proved by its irregular comparison, nigh, near, next.

(*f*) *did* retains the oldest mode of forming the perfect tenses by reduplication. *Do* (A.-S. past tense=*dide*). Cf. L. *dedi*. There is only one other good example of this reduplication in English verbs. This is in *hight* (was called) from the old verb *hâtan* (to call). The Gothic *haihait* shows the reduplication more plainly than the O. E. *hight*.

7. Name the chief writings of the following authors:—Bacon, Pope, Johnson, Hume, Macaulay, and say when each of these writers lived.

Bacon (Francis) lived at the time of James I. and Charles I. He wrote:—'Novum Organum,' 'Essays,' 'Wisdom of the Ancients,' 'History of Henry VII.'

Pope (Alexander) wrote during the reigns of George I. and George II. Chief works:—'Essay on Criticism,' 'Rape of the Lock,' 'Essay on Man,' 'Dunciad,' a satire, Translations of Latin and Greek authors.

Johnson (Dr. Samuel) wrote during the reign of George II. Chief works:—'Dictionary of the English Language,' 'Rasselas,' 'Lives of the Poets,' 'Essays.'

Hume (David) was contemporary with George II. Chiefly noted for 'History of England,' 'Treatise on Human Nature,' 'Essays.'

Macaulay (Lord), a modern poet and prose writer of this reign. He wrote a 'History of England,' 'Essays' for the Edinburgh Review, 'Lays of Ancient Rome,' 'Ivry,' 'The Armada.'

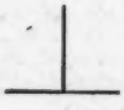
Euclid.

1. (*a*) Define plane superficies, right angle, figure, semicircle, oblong.

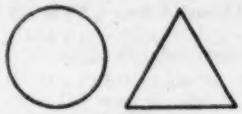
(*b*) The angles at the base of an isosceles triangle are equal to one another; and if the equal sides be produced, the angles on the other side of the base shall be equal.

(*a*) *A plane superfices* is such that if any two points whatever be taken in it, the straight line joining them lies wholly in that superficies.

A right angle is such as either of the angles formed when a straight line stands on another straight line making the adjacent angles equal to each other.

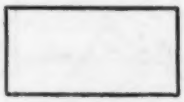


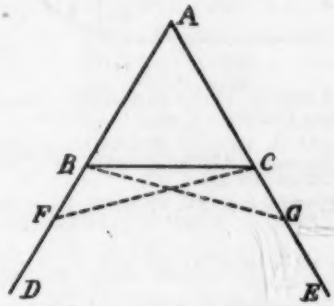
A figure is that which is enclosed by one or more boundaries.



A semicircle is the figure contained by a diameter and the part of the circumference cut off by the diameter.

An oblong is a quadrilateral whose opposite sides are parallel, and whose angles are right angles.



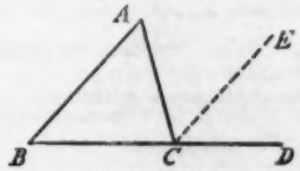


(*b*) *Enunciation.* In the triangle ABC, let AB equal AC, and let AB, AC be produced to D and E. *Construction.* In BD take any point F, and from AE cut off AG equal to AF (I. 3); join BG, CF. *Sequence.* Then the angle ABC equals angle ACB, and angle DBC equals angle ECB.

Proof. In triangles AFC and AGB, we have FA equals GA (const.), AC equals AB (hyp.), and angle FAC equal to GAB. Therefore FC equals GB, angles AFC, AGB are equal, and angle ACF equal to angle ABG (I. 4). Because the whole AF equals whole AG (const.), and the part AB equals part AC (hyp.), ∴ the remainder BF equals remainder CG (I. Ax. 3). In triangles BFC, CGB, we have BF equals CG (proved), FC to GB (proved) and angle BFC equal to angle CGB (proved). Therefore angle BCF equals angle CBG and angle FBC equals angle GCB (I. 4). Because whole angle ABG equals whole ACF (proved), and part ∠CBG equals part ∠BCF (proved), ∴ remainder ∠ABC equals remainder ∠ACB (I. Ax. 3), and these are the angles at the base. But it was proved that angle FBC equals angle GCB: and these are the angles on the other side of the base. Q.E.D.

2. (*a*) If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles; and the three interior angles of every triangle are equal to two right angles.

(*b*) PQR is a right-angled triangle; from the right angle R, RS is drawn bisecting PQ at S, and RT at right angles to PQ, meeting it at T. Show that the angle SRT is equal to the difference of the acute angles at P and Q.



(*a*) *Enunciation.* Let ABC be a triangle having BC produced to D.

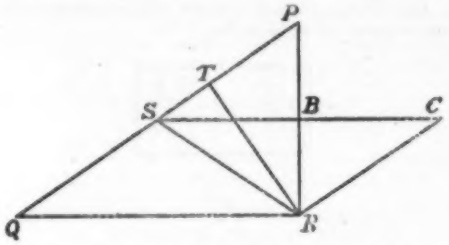
Construction. Through C draw CE ∥ to AB (I. 31).

Sequence. Then ∠ACD equals ∠A and ∠B, and ∠A and ∠B and ∠ACB equal two right angles.

Proof. Because AC meets the ∥'s AB, CE, ∴ ∠A equals alternate ∠ACE (I. 29). Because BD meets the ∥'s AB, CE, ∴ interior ∠B = exterior ∠ECD (I. 29). ∴ ∠A plus ∠B equals ∠ACE plus ∠ECD, *i.e.*, ∠A plus ∠B equals ∠ACD. Because ∠A plus ∠B equals ∠ACD (proved), adding ∠ACB to each of these equals.

∴ ∠A plus ∠B plus ∠ACB equals ∠ACD plus ∠ACB.
,, ,, 2 right angles (I. 13).
Q.E.D.

(*b*) *Enunciation.* Let PQR be the right-angled triangle at R, and let RS be the median to base PQ, and RT the perpendicular *Construction.* Draw SB ∥ to QR and produce it indefinitely.



Through R draw RC ∥ to QP to meet SB produced in C.

Proof.—Then QSCR is a ∥gram.

∴ CR = SQ (I. 34) = SP (Hypoth.), and ∠RCS equals ∠PSC (I. 29), and ∠RBC = ∠PBS (I. 15), ∴ triangle PSB equals △ BCR, and PB equals BR.

Again in △'s SPB and SBR, PB = BR, BS is common, and ∠PBS = ∠SBR. ∴ △SPB = △SBR and SR equals SP. (I. 4).

Wherefore SR = SP = SQ and ∠Q = ∠SRQ (I. 5) and ∠SRP = ∠P (I. 5).

∴ angle P minus angle Q = angle SRP minus angle SRQ
= angle (∠SRT + TRP) minus angle SRQ.

But ∠TRP = ∠Q for ∠TRQ + ∠TRP equals ∠P + ∠Q = ∠TRQ + ∠Q for each side equals a right angle, ∴ ∠TRP = ∠Q.

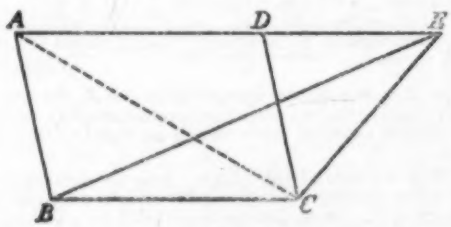
∴ angle P minus angle Q = angle SRT plus angle Q less angle Q.

i.e., angle P minus angle Q equals angle SRT.

Q. E. D.

3. (*a*) If a parallelogram and a triangle be on the same base and between the same parallels, the parallelogram is double of the triangle.

(*b*) T is any point within a parallelogram PQRS, and lines are drawn from it to the angles. Show that the triangles TPQ, TRS are together equal to the triangle PQR.

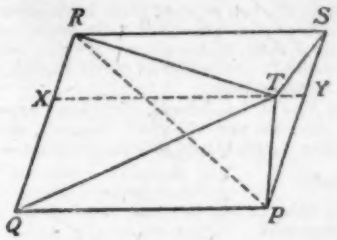


(*a*) *Enunciation.*—Let the ∥gram ABCD and the △EBC be on the same base BC, and between the same parallels AE, BC.

Construction.—Join AC. *Sequence.*—The ∥gram ABCD shall be double of the △EBC.

Proof.—Triangle ABC equals △EBC (I. 37). But ∥gram ABCD is twice △ABC (I. 34). Therefore the ∥gram ABCD is twice the △EBC.

Q. E. D.



(*b*) *Enunciation.*—Let PQRS be the ∥gram, T being the given point, from which lines are drawn to each angle.

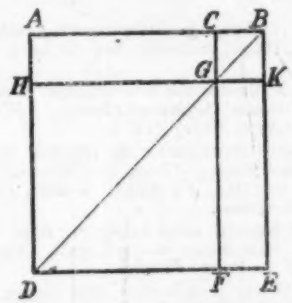
Construction.—Through the given point T draw the line XY ∥ to PQ or RS (I. 31). Join RP. *Sequence.*—Then the triangles TPQ and TRS shall be together equal to triangle PQR.

Proof.—It is evident that the two ∥grams RY and XP are together equal to the whole ∥gram RP.

Now triangle TPQ equals the half of ∥gram XP (I. 41)
and ,, TRS ,, ,, RY (I. 41).
Therefore △'s TPQ, TRS equal the half of ∥grams XP and RY,
i.e., ,, ,, ,, ∥gram RP.
But the △PQR equals ,, ,, RP (I. 34).
Therefore △'s TPQ, TRS are together equal to the △PQR.
Q. E. D.

4. (*a*) If a straight line be divided into any two parts, the square on the whole line is equal to the squares on the two parts, together with twice the rectangle contained by those parts.

(*b*) PQR is a triangle right-angled at P. S is a point in PR. T is a point in PQ. Prove (by I. 47) that the sum of the squares on RT, SQ is equal to the sum of the squares on QR, ST.



(*a*) *Enunciation.*—Let AB be divided into two parts AC and CB.

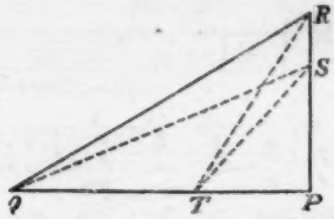
Construction.—On AB describe sq. ADEB and join BD (I. 46). Through C draw CF ∥ AD, meeting DB at G; and through G draw HK ∥ AB, meeting DA and EB at H and K (I. 31). *Sequence.*—The sq. on AB = the sq. on AC with sq. on CB, and twice rect. AC . CB.

Proof.—Because CG ∥ AD, ∴ angle CGB equals angle ADB (I. 29), and because AD equals AB, ∴ angle ADB equals ABD (I. 5). ∴ angle CGB equals angle ABD, which equals angle CBG. ∴ CB equals CG (I. 6). Hence ∥gram CK, having two adjacent sides equal, has all its sides equal (I. 34). But ∥gram CK has one of its angles KBC right, since angle KBC is the same as angle ABE; ∴ it has all its angles right (I. 34); ∴ ∥gram CK is a sq. and equals sq. on CB. (I. Def. 32). Similarly ∥gram HF is a sq. and = HG^2, which is AC^2. Again the ∥gram AG equals rect. AC . CG equals rectangle AC . CB.

∴ GE equals rect. AC . CB (I. 43).

∴ AG and GE equals twice rect. AC . CB.

Now sq. on AB equals ADEB.
,, ,, HF and CK and AG and GE (I. Ax. 8).
,, ,, sq. on AC and sq. on CB and twice rect. AC. CB. Q.E.D.



(*b*) *Enunciation*—Let PQR be the triangle right-angled at P. Let S and T be the given points.

Construction.—Join QS. TR and TS.

Sequence.—The sum of the squares on RT and SQ shall be equal to the sum of the squares on QR and ST.

Proof.—Sq. on RT = sq. on RP and sq. on PT (I. 47).
Sq. on SQ = ,, SP ,, QP (I. 47).
Then squares on RT and SQ = (squares on RP and PQ) with (squares on PT and SP).
But squares on RP and PQ equal sq. on RQ (I. 47).
Again ,, PT ,, SP ,, ST (I. 47).
Therefore squares on RT and SQ equal squares on QR and ST.
Q.E.D.

Algebra.

5. Prove the rule for finding the greatest common measure of two algebraical expressions.

Find it for $6x^3 - 17x^2 + 22x - 15$, and $8x^3 - 22x^2 + 27x - 18$.

(*a*) Let A and B be any two quantities, A being the larger, then G.C.M. = D.

B) A (ρ
ρB
C) B (q
qC
D)C(r
rD

Proof—D will ÷ rD being a multiple of D. ∴ it will ÷ C which = rD. It was shown that it will ÷ C, ∴ it will ÷ any multiple of C, ∴ it will ÷ qC + D. But qC + D = B, ∴ it will ÷ B. Now it was shown that it will ÷ C and B, ∴ it will ÷ any multiple of B, ∴ it will ÷ ρB + C. But ρB + C = A, ∴ it will ÷ A, ∴ it *is a common measure.* Manifestly D is the greatest number that will ÷ D. ∴ D = greatest number that will ÷ rD, a multiple of D; ∴ D is the greatest number that will ÷ C. It was shown that D is the greater number that will ÷ D and C, ∴ it is the greatest number that will ÷ any multiple of C, *i.e.* qC + D = B; ∴ it is the greatest number that will ÷ any multiple of B, *i.e.* ρB + C = A. ∴ it is the *greatest common measure.*

(*b*) $6x^3 - 17x^2 + 22x - 15)\ 8x^3 - 22x^2 + 27x - 18($
$6x^3 - 15x^2 + 15x - 9$; $6x^3 - 17x^2 + 22x - 15$
$-2x^2 + 7x - 6)\ 2x^2 - 5x^2 + 5x - 3($
$-2x^2 + 3x$; $2x^2 - 7x^2 \quad (6x + 6x)$
$4x - 6$; $2x^2 - x - 3$
$4x - 6$; $2x^2 - 7x + 6$
$6x - 9$
$\div 3 = 2x - 3$
∴ $2x - 3$ = G.C.M. Ans.

6. Show that—(*a*) $(7a + 6b + 5c)^2 - (5a + 6b + 7c)^2 = 24(a - c)(a + b + c)$; and simplify—

(*b*) $\dfrac{1}{x - y} - \dfrac{2x}{x^2 - y^2} - \dfrac{3x^2}{x^3 - y^3}$.

(*a*) $(7a + 6b + 5c)^2 - (5a + 6b + 7c)^2 = 24(a - c)(a + b + c)$
$\{(7a + 6b + 5c) + (5a + 6b + 7c)\}\ \{(7a + 6b + 5c) + (-5a - 6b - 7c)\}$ = do.
$(12a + 12b + 12c)(2a - 2c)$ = do.
i.e. $24(a + b + c)(a - c) = 24(a - c)(a + b + c)$. Q.E.D.

(*b*) $\dfrac{1}{x - y} - \dfrac{2x}{x^2 - y^2} - \dfrac{3x^2}{x^3 - y^3}$ L.C.M. $(x + y)(x^2 - y^2)$.

$= \dfrac{1}{(x - y)} - \dfrac{2x}{(x - y)(x + y)} - \dfrac{5x^2}{(x - y)(x^2 + xy + y^2)}$

$= \dfrac{(x + y)(x^2 + xy + y^2) - 2x(x^2 + xy + y^2) - 3x^2(x + y)}{(x + y)(x^3 - y^3)}$

$= \dfrac{x^3 + 2x^2y + 2xy^2 + y^3 - 2x^3 - 2x^2y - 2xy^2 - 3x^3 - 3x^2y}{(x + y)(x^3 - y^3)}$

$= \dfrac{-4x^3 - 3x^2y + y^3}{(x + y)(x^3 - y^3)} = \dfrac{y^3 - x^2(4x + 3y)}{(x + y)(x^3 - y^3)}$. Ans.

7. Solve the equations:—

(1) $\dfrac{3x - 8}{25} + \dfrac{4x - 9}{35} = \dfrac{5x - 27}{14}$

(2) $\left.\begin{aligned} \dfrac{2y - 25}{3} - \dfrac{6 - x}{7} &= \dfrac{2(y - 7)}{5} \\ \dfrac{29 - x}{8} - \dfrac{3y - 1}{10} &= \dfrac{4 - x}{3} \end{aligned}\right\}$

(3) $\dfrac{13}{2x - 1} - \dfrac{10}{3x - 1} = \frac{1}{2}$.

(1) $\dfrac{3x - 8}{25} + \dfrac{4x - 9}{35} = \dfrac{5x - 27}{14}$

$42x - 112 + 40x - 90 = 125x - 675$
$675 - 202 = 125x - 82x$
∴ $43x = 473$. *i.e.*, $x = 11$. Ans.

(2) (*a*) $\dfrac{2y - 35}{3} - \dfrac{6 - x}{7} = \dfrac{2(y - 7)}{5}$ L.C.M. 105

$70y - 875 - 90 + 15x = 42y - 294$
$15x + 28y = 965 - 294 = 671$ ..... (*a*)

(*b*) $\dfrac{29 - x}{8} - \dfrac{3y - 1}{10} = \dfrac{4 - x}{3}$ L.C.M. 120.

$435 - 15x - 36y + 12 = 160 - 40x$
$25x - 36y = 160 - 447 = -287$ ..... (*b*)
$75x + 140y = 3355$ ..... (*a*)
$75x - 108y = -861$ ..... (*b*)
By subtraction $248y = 4216$. ∴ $y = 17$

By substitution in (*a*) $15x + 476 = 671$; $15x = 195$ ∴ $x = 13$ } $x = 13$, $y = 17$ } Ans.

(3) $\dfrac{13}{2x - 1} - \dfrac{10}{3x - 1} = \frac{1}{2}$. L.C.M. $= 2(2x - 1)(3x - 1)$

$26(3x - 1) - 20(2x - 1) = (2x - 1)(3x - 1)$
$78x - 26 - 40x + 20 = 6x^2 - 2x - 3x + 1$
$-7 = 6x^2 - 43x$
∴ $x^2 - \dfrac{43x}{6} + (\frac{43}{12})^2 = (\frac{43}{12})^2 - \frac{49}{144}$
∴ $x - \frac{43}{12} = \sqrt{\dfrac{1849 - 168}{12^2}} = \sqrt{\dfrac{1681}{12^2}} = \frac{41}{12}$
∴ $x = \frac{43}{12} \pm \frac{41}{12} = 7$ or $\frac{1}{6}$. Ans.

8. One hundred and ninety-four sticks (some of which are each a yard long, and the rest are each a foot long) are placed in contact in a straight line, and measure a distance of half a furlong. How many were there of each length?

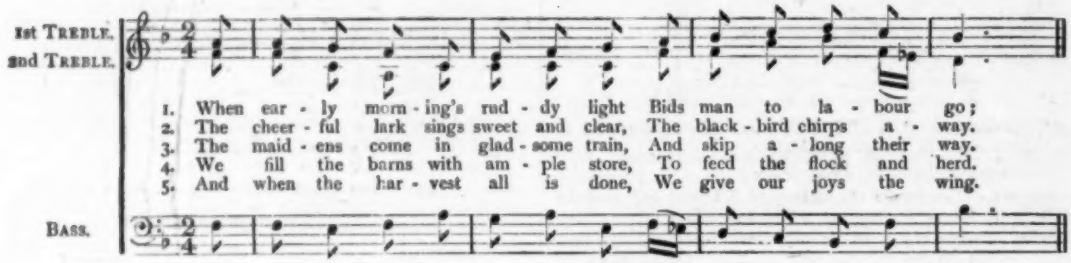
Let x = No. a yard long. Then $194 - x$ = No. a foot long.
By sum $3x + 194 - x = 3(110)$
$3x - x = 330 - 194$
∴ $2x = 136$, ∴ $x = 68$ a yd. long
and ∴ $(194 - 68) = 126$ and ∴ 126 a ft. long } Ans.

9. Find two numbers whose sum is 22, and the sum of their squares is 250.

Let x = one No. and y = the other No.
Then $x + y = 22$ ..... (1) and $x^2 + y^2 = 250$ ..... (2)
From (1) we get $y = 22 - x$.
By substitution in (2) $x^2 + (22 - x)^2 = 250$
i.e., $x^2 + 484 - 44x + x^2 = 250$
$2x^2 - 44x = 234$
$x^2 - 22x + (11)^2 = (11)^2 - 117 = 121 - 117 = 4$
∴ $x - 11 = \sqrt{4} = 2$ and $x = 11 \pm 2 = 13$ or 9
Therefore the two numbers are 13 and 9. Ans.

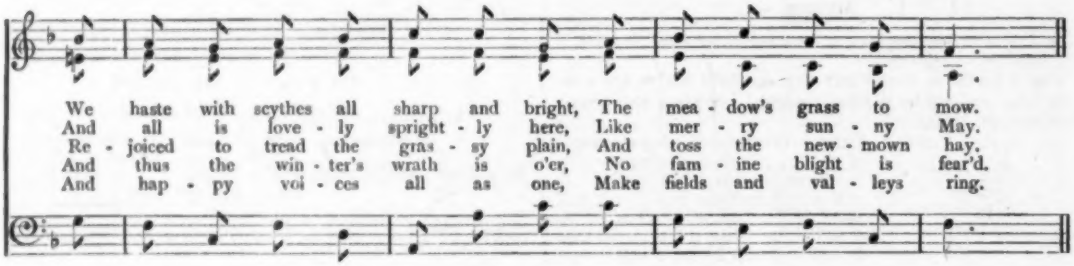
—9—

THE MOWERS.

Allegretto Moderato. *mf.* *Tune*:—'CHEVY CHASE.'

1st TREBLE.
2nd TREBLE.
BASS.
1. When ear - ly morn - ing's rud - dy light Bids man to la - bour go;
2. The cheer - ful lark sings sweet and clear, The black - bird chirps a - way.
3. The maid - ens come in glad - some train, And skip a - long their way.
4. We fill the barns with am - ple store, To feed the flock and herd.
5. And when the har - vest all is done, We give our joys the wing.

KEY F. *Allegretto Moderato.* *mf.*

1st TREBLE.	.m	m	.r	:d	.s$_1$	t$_1$	.d	:r	.m	f	.s	:l	.s	f	:-	.
2nd TREBLE.	.d	d	.s$_1$	:m$_1$	.s$_1$	s$_1$	.s$_1$	:s$_1$	.d	d	.m	:f	.d,ta$_1$	l$_1$	:-	.
BASS.	.d	d	.t$_1$	:d	.m	r	.m	:t$_1$	.d,ta$_1$	l$_1$	.s$_1$	:f$_1$	.d	f	:-	.


We haste with scythes all sharp and bright, The mea - dow's grass to mow.
And all is love - ly spright - ly here, Like mer - ry sun - ny May.
Re - joiced to tread the gras - sy plain, And toss the new - mown hay.
And thus the win - ter's wrath is o'er, No fam - ine blight is fear'd.
And hap - py voi - ces all as one, Make fields and val - leys ring.

	.f	m	.r	:m	.f	s	.s	:r	.m	f	.s	:m	.r	d	:-	.
	.t$_1$	d	.t$_1$	:d	.d	d	.d	:t$_1$	.d	t$_1$	.s$_1$	:s$_1$	.f$_1$	m$_1$	:-	.
	.r	d	.s$_1$	:d	.l$_1$	m$_1$	.m	:s	.s	r	.t$_1$	:d	.s$_1$	d	:-	.

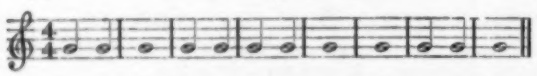
How to Teach School Children to Sing from the Staff Notation.

BY W. G. McNAUGHT,

Associate of The Royal Academy of Music.

78. Exercises on quavers were given in section 44 (July, 1890). Semibreves as four-pulse notes present no difficulty, but as they may be mistaken for minims it will be well to occasionally give special exercises introducing only minims and semibreves so as to accustom the eye to note the presence or absence of the stem.

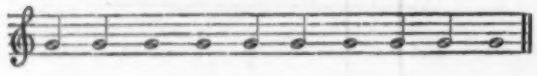
(1) *Example.*



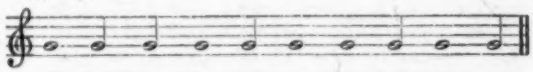
An unbarred exercise the minims in which are repeatedly altered to semibreves and *vice versa*, will be found useful in giving this lesson.

Examples.

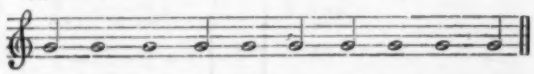
(2) 1st Form.



(3) Altered.

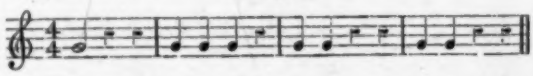


(4) Altered.

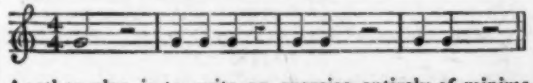


79. The minim rest is not specifically mentioned in the Code Requirements. It should, however, be introduced when the crotchet rest is quite familiar. The teacher should take care to write the oblong sign *on* the *third* line first, just as he must always place the crotchet rest *between* the third and fourth lines. The minim rest may be introduced as a substitute for two successive crotchet rests.

(1) *Examples.*

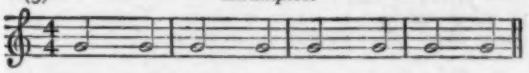


(2) *The same with Minim Rests.*

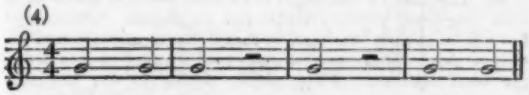


Another plan is to write an exercise entirely of minims and to gradually alter the minims into corresponding rests.

(3) *Examples.*



(4)



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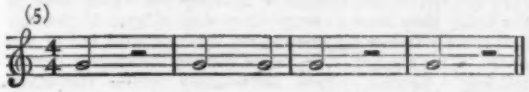
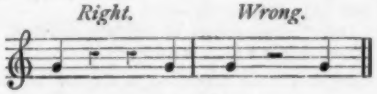


It would be unwise just now to introduce the semibreve rest. The unlucky use of one shape for both minim and semibreve rests and the consequent dependence upon mere position being noted is a source of confusion to many musical people. The distinction should be left for special practice at some later stage.

80. The minim rest in the examples given above is employed on the 'medium' accent of the four-pulse measure. As this accent is relatively weak to the first pulse in the bar, the Code requirement as to the use of rests on accented parts of the bar is hardly exceeded, especially when the rest is used in an exercise consisting chiefly of minims.

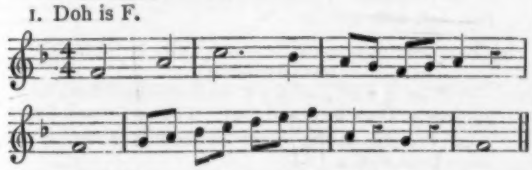
81. The minim rest should *not* be substituted for two crotchet rests when the second beat or pulse is a stronger accent than the first.

Right. *Wrong.*

82. The following are—

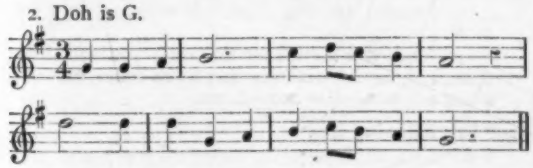
SPECIMEN CODE TESTS FOR DIVISION III.

These exercises are written in tune although only monotone time is required by the Code. They should be written on one line at first and used as time and tune combined at a later stage.

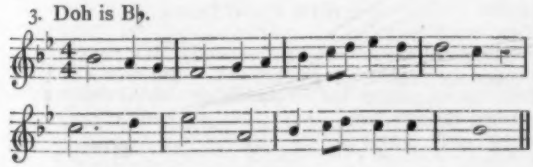
1. Doh is F.



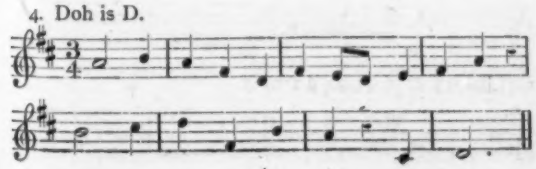
2. Doh is G.



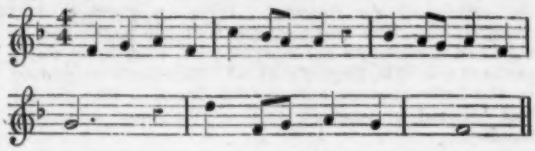
3. Doh is B♭.

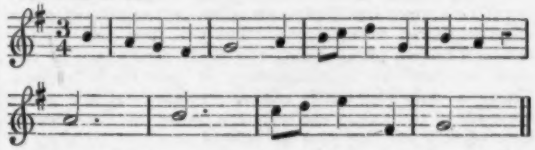


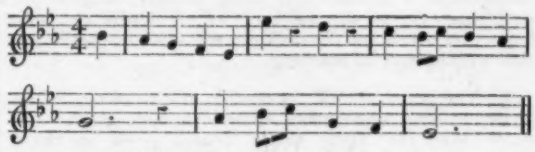
4. Doh is D.



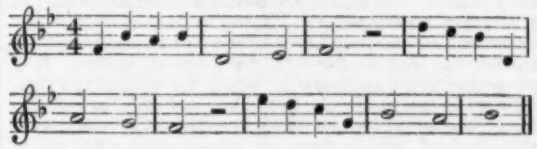
5. Doh is F.



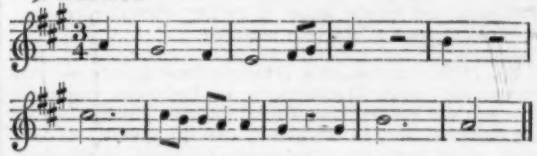
6. Doh is G.

7. Doh is E♭.



8. Doh is B♭. (*With Minim Rests.*)



9. Doh is A.



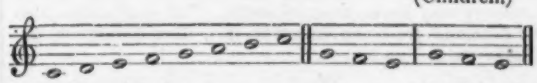
DIVISION III.—EAR TEST.

CODE REQUIREMENT.

Ear Test.—To repeat and afterwards name any three CONSECUTIVE *notes of the scale of C which the Examiner may twice sing to the syllable* LAA (*or play*), EACH *time first giving the chord or the scale of C.*

Example:

(Children.)



(By Examiner.) *Soh, Fah, Me.*

This test should be applied only to the more advanced children of this division.

83. If the naming of ear exercises have been properly begun and regularly practised in Division II., as recommended in Sections 52 to 54 (Sept. 1890), the inherent difficulty of this test will be considerably relieved in the higher Divisions. If, however, nothing has been done, the plans recommended in the sections referred to should be adopted as a start.

84. The application of ear exercises to a large class severely tests a teacher's musical capacity and his ability in class management. On all sides Inspectors complain that ear-tests are often badly answered even where the singing is otherwise good, and teachers are constantly complaining of the difficulty of the task or of the dulness of their pupils.

85. One point must ever be kept in mind in looking for results of ear training. With an average class enjoying the best teaching not half the pupils can be expected to tell as an ear exercise what they could freely perform as a sight-singing exercise. This fact is recognised in the Code requirements by the direction that the ear test 'should be applied only to the more advanced children.'

86. No teacher must look for good results in ear training if he cannot freely give an abundant variety of exercises at almost every lesson. To give now and then a few well known phrases only too easily recognised by the class as familiar acquaintances is practically useless. There is only too much reason to fear that the great majority of failures in ear tests are owing to the general lack of skill on the part of school teachers to sing to '*laa*' any series of scale tones they design to sing. Knowledge of this inability leads teachers to give but little attention to the subject and to indulge the vain hope that somehow the children will pick up necessary skill without special teaching.

87. The practical skill the teacher has to attain is the power to sing scale tones without naming them. To quote from the Tonic Sol-fa Course given in these columns in Vols. VIII. and IX., 'The obvious course for a teacher is to find every possible opportunity for the practice of vocalising (*i.e.*, singing to *laa*) at sight. Ear exercises can certainly never have a fair chance until the teacher can sing to *laa* with the greatest facility. It is altogether unfair to blame the pupils for a teacher's deficiencies in this respect.' A teacher not able to vocalise freely should get some skilled instruction. Generally, this kind of help is best got from a good tonic sol-fa teacher. Very few professional musicians, not tonic sol-faists, are in the habit of giving scientifically constructed courses of the kind required.

88. In this connection it is fair to draw attention to an Automatic Sol-fa Harmonium, an ingenious invention that enables the weakest teacher to give any number of ear exercises and to confidently check answers. It consists of an ordinary harmonium, to which is attached mechanism that simultaneously with the performance of a note a card bearing its sol-fa name is exhibited. This card can be shown to or concealed from the class at the will of the player. Exercises can be given in any key, a slight adjustment of the mechanism fixing the 'doh' to any part of the keyboard. The player need not be a skilful performer. Anyone of ordinary musical intelligence can learn all that is necessary for ear exercises in an hour or two. There are many other uses to which the instrument can be put by a 'voiceless' and 'earless' teacher. The harmonium can be also used in the ordinary way for accompaniments. Full particulars can be obtained from the inventor, Mr. Alex. Adamson, 94, Nethergate, Dundee.

89. Assuming the skill of the teacher or the possession of the instrument described the ear exercises now given should be most carefully planned to meet the powers of the class. As these powers must of necessity vary considerably in a large class, it is part of the teacher's duty to gradually sort his class into sections, so that he can always call upon the weakest or the strongest as he feels disposed. If no such classification is attempted, and he is content simply to find that someone, no matter who, answers questions, only the clever ones will answer, and the others will acquire a habit of saying anything or nothing. Some of the exercises should be designed to meet the powers of the weakest in the class, even if it is found necessary to descend to the level of asking whether a very low note and a very high one are the same or different. It is a good plan to give the most difficult exercises first, and as these are answered by the brighter pupils to forbid them to answer further questions. Require the others to stand, and allow them to sit as they answer. Give plenty of easy exercises to this section. Promote to other sections as merit is shown. Constantly give pupils some reason for striving to get on.

89. The task of the pupil is to find the real name of a tone disguised by the syllable *laa* or played. Obviously, he will be greatly assisted in this if he is accustomed to sing to *laa*. There are two ways of singing to *laa* from the staff notation. First, pupils prefer to *laa* because they are spared the trouble of making out which note of the scale they have to sing—they sing almost at random and merely follow approximately the rise and fall of the notes. This kind of *laaing* is, of course, thoroughly demoralising. Second, pupils consciously realise the scale position of the tones, and probably think the sol-fa name. This is the only kind of *laaing* of any use for sight-singing, and the only kind likely to favourably affect ear-telling. As the practice of *laaing* unfamiliar music is a strain upon the attention it should be most carefully watched by the teacher and attempted only when the class is fresh and inclined for work.

90. It is not necessary to use the staff in giving ear exercises. The tones of the scale have to be identified, and so only the sol-fa names need be used. The following is an epitome of the plan recommended :—

(*a*) Exercises to stimulate attention.

(1) The scale up or down some tone to be repeated.

(2) The same, some tone to be omitted.

(3) Repeat two tones, *e.g.*, **d d s s s** or **d s s** or **d d s** and ask how often each came.

(4) Offer alternatives of widely different things, *e.g.*, Do I sing **s t d'** or **m r d**?

(*b*) Exercises that draw attention to the mental effects of tones.

(1) Bring out the expectancy of **ray, fah, lah, te** by ending phrases short on these tones in turn.

(2) Show how **ray** suggests **doh, te** the high **doh'**, **fah,** the **me,** and **lah,** the **soh** or the **te**.

(3) Demonstrate repeatedly the repose of **doh** and **me** and the firm hard effect of **soh**.

(4) Illustrate repeatedly the emotional effects of **ray, fah, lah,** and **te**.

(*c*) Exercises to prepare for Code Tests of three consecutive tones.

(1) Get **l t d'** and **s l t** distinguished from one another. Then **m r d** and **f m r**. Then **s f m** and **f m r**.

(2) Promise to sing three consecutive notes up *or* down from **m** or **s**.

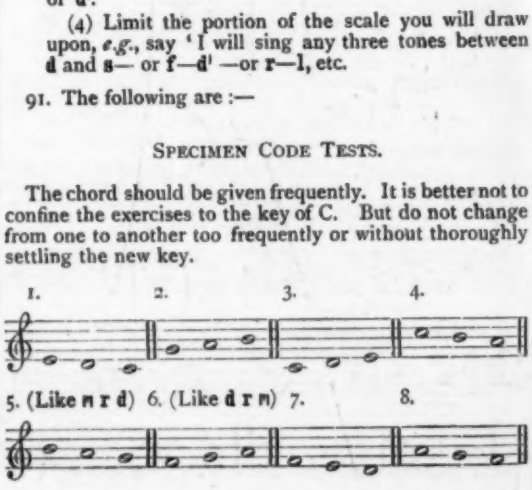
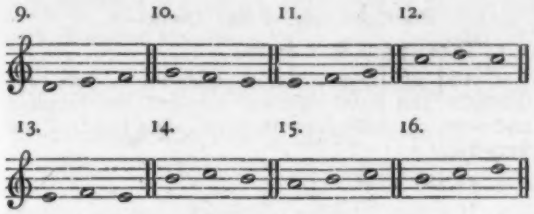
(3) Promise to sing ditto, commencing on **d m s** or **d'**.

(4) Limit the portion of the scale you will draw upon, *e.g.*, say 'I will sing any three tones between **d** and **s**— or **f**—**d'** —or **r**—**l**, etc.

91. The following are :—

SPECIMEN CODE TESTS.

The chord should be given frequently. It is better not to confine the exercises to the key of C. But do not change from one to another too frequently or without thoroughly settling the new key.



(To be continued.)

Tests in Mental Arithmetic.

STANDARD I.

1. How many penny cakes could you get for 1s. 6d.? 18.
2. How many twopenny ones could you get? 9.
3. How many threepenny ones could you get? 6.
4. How much would 2½ threepenny ones cost? 7½d.
5. How many quarters could you get out of five apples? 20.
6. How many apples must be cut up to get 28 quarters? 7.
7. How many must you cut up to get 30 quarters? 8.
8. How much would you have left? ½ an apple.
9. A boy had a shilling, and he spent a penny. How many halfpenny oranges could he buy with the remainder? 22.
10. How much would 19 cost? 9½d.
11. What would 4 lbs. of rice cost at 2 lbs. for 3½d.? 7d.
12. How much would 8 lbs. cost? 1s. 2d.

STANDARD II.

1. How many must you add to two dozen to make two score? 16.
2. Take 16 from half-a-hundred. 34.
3. Add 6¼d., 5½d., and 4d. 1s. 4d.
4. How many halfpence could you get for that? 32.
5. What is the cost of 3 books at 1s. 4d. each? 4s.
6. What change would you get out of a florin and half-a-crown? 6d.
7. How many articles could you get for half-a-sovereign at 6d. each 20.
8. A farmer sold 4 sheep at £3 each, and spent £2. How much had he left? £10.
9. If he changed it into shillings how many would he have? 200.
10. What would 60 lbs. of sugar cost at 3d. per lb? 15s.
11. What would it cost at 2d. per lb.? 10s.
12. What would it cost at 1½d. per lb.? 7s. 6d.

STANDARD III.

1. Divide two guineas among 3 boys and 4 girls. How much is that for each? 6s.
2. How many eggs could you get for 6s. at 3 for 2d.? 108.
3. How many more than 5 score is that number? 8.
4. A farmer bought 3 sheep for £7 10s., and sold them at £3 each. How much did he gain? £1 10s.
5. How many stone are there in 2 cwt.? 16.
6. What would 2 cwt. of turnips cost at 4d. per stone? 5s. 4d.
7. What is the cost of ½ ton of coal at 9d. per cwt.? 7s. 6d.
8. What would 1½ tons cost? £1 2s. 6d.
9. How many pints are there in 3 gallons? 24.
10. What would 3 gallons of milk cost at 1½d. per pint? 3s.
11. How many lbs. of butter, at 1s. 3d. per lb., could you buy for 5s.? 4.
12. What would 2½ lbs. cost.? 3s. 1½d.

STANDARD IV.

1. How many yards are there in 3 furlongs? 660.
2. How many chains are there in three miles? 240.
3. What is the cost of 3 miles of wire at 6d. a chain? £6.
4. What is the cost of an acre at a shilling a square yard? £121.
5. What would it cost at 3d. a square yard? £30 5s.
6. What would it cost at 4d. a square yard? £40 6s. 8d.
7. What is the cost of 90 yards at 8d. a foot? £9.
8. What part of half-a-crown is 7½d.? ¼.
9. What part of half-a-sovereign is it? $\frac{1}{16}$.
10. How many weeks are there in 2½ years? 130.
11. How much would a boy save in that time if he put away 2d. weekly? £1 1s. 8d.
12. How much would he save if he put away 8d. weekly? £4 6s. 8d.

STANDARD V.

1. What would 6½ yards cost at 1s. 6d. for half-a-foot? £2 18s. 6d.
2. What is the cost of 6 qrs. at 6s. a bushel? £14 8s.
3. How much will a man spend during January at 13s. 4d. a day? £20 13s. 4d.
4. An article is bought for a florin, and sold for half-a-crown. What part of the cost price is the profit? ¼.
5. What part is it of the selling price? ⅕.
6. If the cost price had been half-a-crown, what would have been the selling price? 3s. 1½d.
7. Take $\frac{5}{6}$ from $\frac{6}{7}$. $\frac{1}{42}$.
8. Add $\frac{5}{8}$ and $\frac{6}{7}$. $1\frac{38}{42}$.

9. How much must be added to that result to make 3? $1\frac{3}{2}$.

10. If $\frac{5}{8}$ of a sheep is worth £2 5s., what is the value of the whole sheep? £2 14s.

11. Express $\frac{1}{4}$ of $\frac{9}{10}$ as a decimal. ·225.

12. What is the interest on £25 for 3 months at 3 per cent.? 3s. 9d.

STANDARDS VI. AND VII.

1. What fraction of £1 is 1s. 2d.? $\frac{7}{120}$.

2. What decimal is it? ·058$\dot{3}$.

3. By dividing a number by $3\frac{1}{2}$ I obtained 56 as the result. What was the number? 196.

4. By multiplying a number by $3\frac{1}{2}$ I obtained 56 as the result. What was the number? 16.

5. What is $\frac{3}{4}$ of $\frac{8}{9}$ of a guinea? 14s.

6. What is $\frac{5}{6}$ of $1\frac{1}{2}$ tons? 1 ton 5 cwt.

7. In what time will £75 gain £36 at 4 per cent.? 12 years.

8. At what rule per cent. would it gain £42 in the same time? $4\frac{2}{3}$ per cent.

9. An article was bought for 2s., and sold at a gain of $16\frac{2}{3}$ per cent. What was the selling price? 2s. 4d.

10. If a guinea had been the selling price, what would have been the cost price? 18s.

11. How much must be invested in the $3\frac{1}{2}$ per cents. at $89\frac{7}{8}$ to get an income of £28, brokerage being $\frac{1}{8}$ per cent.? £720.

12. What is the rule per cent. received? $3\frac{5}{9}$ per cent.

—o—

Quarterly Arithmetical Tests.

BY JOSEPH WOLLMAN,

Head Master of the Wellgate Board School, Rotherham.

STANDARD I.—FIRST QUARTER.

1. 46, 5, 280, 17, 4

2. 590, 420

3. 786, 731

4. How many nuts did five boys gather, when one got 153, another 86, another 69, another 204, and the other 75?

SECOND QUARTER.

1. 509, 6, 738, 92, 451

2. 417, 41

3. 854, 8

4. There are 309 children in a school, and 184 are girls. How many boys are there?

THIRD QUARTER.

1. 7, 928, 49, 876, 5

2. 500, 27

3. 740, 153

4. I put in the bank 38 pounds and 56 pounds, and drew out 47 pounds and 25 pounds. How much have I in the bank yet?

STANDARD II.—FIRST QUARTER.

1. Take 47,308 from 83,204.

2. Add fifty thousand and eighty-seven, 796, nine thousand and four, eighteen thousand two hundred and sixty, 59, and seven thousand eight hundred and forty-five.

3. 56,789 × 46.

4. If a man can carry nine bricks, how many bricks can 954 men carry?

SECOND QUARTER.

1. Find the product of 40,690 and 708.

2. Find the fourth part of 27,620, and write the answer in words.

3. From ten thousand and eleven take 745.

4. In a bank there were 9,704 sovereigns; 3,498 were paid away, and 1,057 were paid in. How many sovereigns were there then in the bank?

THIRD QUARTER.

1. 76,009 ÷ 11.

2. Find the difference between 30,004 and 9,099.

3. Multiply 986 by 5,706.

4. How many are eight times the ninth part of 51,102?

STANDARD III.—FIRST QUARTER.

1. Divide 250,196 by 37.

2. What is the quotient of 828,084 and 914?

3. If a man writes 18 letters every day for 17 years, how many does he write altogether, reckoning 365 days in a year?

4. What is the least number that must be added to a million to make it exactly divisible by 59?

SECOND QUARTER.

1. I want 1s. $5\frac{3}{4}$d. to make a thousand pounds. How much have I?

2. £263 15s. $8\frac{1}{4}$d. + £47 16s. $5\frac{1}{2}$d. + £311 18s. $7\frac{3}{4}$d. + £5 12s. $9\frac{1}{2}$d. + £829 11s. 6d. + £74 14s. $11\frac{3}{4}$d. + 19s. $10\frac{1}{2}$d.

3. How many times is 235 contained in 948,930?

4. A shopkeeper bought goods for £38 14s. 9d. and paid £2 17s. 6d. for carriage. He sold them for £50 10s. How much did he gain?

THIRD QUARTER.

1. Find the sum of £54,963 11s. $7\frac{1}{2}$d., £37,249 16s. $4\frac{3}{4}$d., £60,875 19s $10\frac{1}{4}$d., £82,617 14s. $9\frac{1}{4}$d., and £79,350 18s. $11\frac{1}{2}$d.

2. Multiply 78,096 by 549, and test your answer by long division.

3. What is the difference between £7,408 15s. $2\frac{1}{4}$d. and £20,054 12s. $0\frac{3}{4}$d.?

4. A dealer bought one thousand eggs for two guineas. He sold half at 20 a shilling, and the remainder at a penny each. What did he gain?

STANDARD IV.—FIRST QUARTER.

1. What is the difference between a quarter of a million sovereigns and £97,058 12s. $7\frac{1}{4}$d.?

2. Multiply £7,508 17s. 11½d. by 850.

3. £15,000 15s. 0½d. ÷ 67.

4. A draper bought 300 yards of silk at 7s 10d. a yard, and sold it at 9s. 9d. a yard; what was his profit?

SECOND QUARTER.

1. Reduce three quarters of a million square feet to roods, &c.

2. At a concert £3 17s. 6d. was taken in half-crowns, £4 18s. in florins, £2 12s. in shillings, and £1 19s. 6d. in sixpences. How many coins were taken altogether?

3. Reduce 7 miles 6 fur. 8 chains 19 yds. to inches.

4. Tea was bought at £252 per ton, and sold at a gain of 5d. per lb. What was the selling price per lb.?

THIRD QUARTER.

1. If a horse costs £13 1s. 3d. for food for 13 wks. 4 days, how much is that daily?

2. Reduce 219 tons 13 cwt. 58 lbs. 11 oz. to oz.

3. If 3,407 pints be subtracted from 78 bus. 2 pks. 1 gal. 3 qts., how many pints will remain?

4. The expenses of an entertainment amount to six guineas. Find the profit if there were sold 486 tickets at a penny each, 378 at threepence, and 65 at sixpence.

STANDARD V.—FIRST QUARTER.

1. What is the value of 19,703 articles at £17 14s. 8½d. each?

2. Find the value of 7 tons 12 cwt. 2 qrs. 19 lbs. of rice at £16 6s. 8d. per ton.

3. A shop-keeper bought an equal number of pine-apples at 3s. 6d. and 3s. 9d. each, and paid £9 1s. 3d. for them. How many did he buy?

4. What is the value of 9 bins of oats, each containing 6 qrs. 5 bus. 3 pks., at £1 8s. 8d. per quarter?

SECOND QUARTER.

1. If 56 men cut 32 acres in 16½ days, how long will it take 84 men to cut the same quantity?

2. What is the cost of making a road 7 fur. 28 po. long at £29 6s. 8d. per mile?

3. What quantity of wine, at the rate of £15 18s. 2d. for 23 gallons, can be bought for £58 15s. 10d.?

4. Bill:—

19 yards of cloth at 5s. 11d. per yard;
27 „ calico at 4¼d. per yard;
100 gross of buttons at 3½d. per doz.;
15½ doz. reels of cotton at 3 for 2d.;
38 doz. needles at 1s. 9d. a gross.

THIRD QUARTER.

1. An income-tax of 5d. in the pound is paid on £876 12s. How much remains?

2. From the greatest of the following fractions subtract the least:—

$\frac{7}{9}$, $\frac{5}{12}$, $\frac{9}{10}$, $\frac{6}{11}$.

3. A grocer bought 4½ tons of sugar for £168, and had 1 cwt. 8 lbs. waste; what must he sell it at per lb. to gain £39 10s.?

4. What must I add to the sum of $\frac{2}{9}$ and $\frac{5}{12}$ to make $\frac{5}{7}$?

STANDARD VI.—FIRST QUARTER.

1. Take $\frac{7\frac{1}{2}}{8\frac{1}{4}}$ of 12 from $\frac{5\frac{3}{5}}{4\frac{2}{3}}$ of 9.

2. 4·32 — 3·647 + 5·9128 — 1·07356.

3. Simplify:—

$$\frac{(4 + \frac{1}{6}) \div (5 + \frac{1}{8})}{(3 - \frac{1}{9}) \times (2 - \frac{1}{7})}.$$

4. Divide $\frac{3\cdot8\dot{5}}{3\cdot\dot{6}}$ by $\frac{4\cdot\dot{2}\dot{7}}{5\cdot875}$, and give the answer as a decimal.

SECOND QUARTER.

1. What is the sum of ·0675 of a guinea, 3125 of a crown, and ·87675 of a florin?

2. After an allowance of 2d. in the shilling discount, a man paid £3 5s. 10d. What was the amount of the bill?

3. If a first class had ·1$\dot{6}$ of the scholars, the second ·15, the third ·$\dot{4}$, and the fourth 86, how many scholars were in the school?

4. Reduce 37 yards to the decimal of 1¼ miles.

THIRD QUARTER.

1. A parish, containing 2,880 acres, is rated on a rental of £6,120; a rate of 8d. in the £ is levied. What is the charge per acre?

2. What is the amount of £982 10s. for 3 years at 4½ per cent.?

3. Find the value of 4·875 of £137 19s. 10d. multiplied by 7·$\dot{6}$.

4. At what rate per cent. will the interest on £597 10s. amount to £62 14s. 9d. in 3½ years?

STANDARD VII.—FIRST QUARTER.

1. If $\frac{5}{8}$ of a son's age is equal to $\frac{1}{3}$ of his father's age, and the difference of their ages is 34 years, what is the father's age?

2. A banker allows 3 per cent. on sums deposited in his bank. What sum must I invest so that in 6 years I can withdraw £920 8s.?

3. Find the smallest sum of money that can be divided into shares of £19 12s. 6d. and £17 13s. 4d.

4. What is a quarter's rent of 276·18$\dot{5}$ acres at £11·475 per acre per annum?

SECOND QUARTER.

1. If 12 men, 20 women, and 28 boys can complete a piece of work in 24 days, how long will it take 18 men, 8 women, and 10 boys, 3 men doing as much work as 5 boys, and 2 women doing as much as 3 boys?

2. A farmer bought a flock of 250 sheep for £560. Half were bought at £2 10s. each, and a fifth at £3 each. What was the average price of the remainder?

3. After paying a tax of 7½ per cent. I had £5,180 left. What was my income?

4. A man gained £300 in business the first year; the second year he gained 10 per cent. more, the third year 10 per cent more than the second year, and the fourth year 10 per cent. more than the third year. What was his annual average gain for the 4 years?

THIRD QUARTER.

1. I invested £5,385 in the 3 per cents. at 89¾. What is my gain if I sell out when the stock has risen to 91½?

2. A builder gained 15 per cent. by selling a house for £782. What would he have gained per cent. by selling it for £809 4s.?

3. A person sold £3,500 stock out of the 3 per cents. at 92, and re-invested in the 3¼ per cents. at 103½. What was the improvement in his income?

4. A and B can do a piece of work in 5 days, B and C can do it in 3 days, and A, B, and C can do it in 2 days. How long would it take B alone to do it.

ANSWERS.

STANDARD I.

FIRST.	SECOND.	THIRD.
1. 352.	1,796.	1,865.
2. 170.	376.	473.
3. 55.	846.	587.
4. 587 nuts.	125 boys.	22 pounds.

STANDARD II.

FIRST.	SECOND.	THIRD.
1. 35,896.	28,808,520.	6,909 + 10.
2. 86,051.	6,905.	20,905.
3. 2,612,294.	9,266.	5,626,116.
4. 8,586 bricks.	7,263 sovereigns.	45,424.

STANDARD III.

FIRST.	SECOND.	THIRD.
1. 6,762 + 2.	£999 18s. 6½d.	£315,058 1s. 7½d.
2. 906.	£1,534 9s. 11½d.	42,874,704.
3. 111,690 letters.	4,038 times.	£12,645 16s. 10½d.
4. 50.	£8 17s. 9d.	£1 4s. 8d.

STANDARD IV.

FIRST.	SECOND.
1. £152,941 7s. 4¾d.	68 ro. 34 sq. po. 24½ sq. yds 3 sq. ft.
2. £6,382,562 6s. 10½d.	211 coins.
3. £223 17s. 10d. + 10 q.	498,060 inches.
4. £28 15s.	2s. 8d.

THIRD.	
1. 2s. 9d.	3. 1,631 pints.
2. 7,873,195 ounces.	4. £2 1s. 6d.

STANDARD V.—FIRST.

1. £349,440 18s. 3½d.	3. 50 pineapples.
2. £124 13s. 7¼d.	4. £86 13s. 5½d.

SECOND.

1. 11 days.
2. £28 4s. 8d.
3. 85 gallons.
4. £5 12s. 5d. + 9s. 6¾d. + £17 10s. + 10s. 4d. + 5s 6½d. = £24 7s. 10¼d.

THIRD.	
1. £858 6s. 9d.	3. 5d.
2. ⅔.	4. $\frac{44}{117}$.

STANDARD VI.

FIRST.	SECOND.	THIRD.
1. ⅞.	4s. 8$\frac{4}{11}$d.	1s. 5d.
2. 5·51224.	£3 19s.	£1,122 10s. 1½d.
3. $\frac{1944}{4913}$.	360 scholars.	£5,157 8s. 9¼d.
4. 1·44583.	·01681.	3 per cent.

STANDARD VII.

FIRST.	SECOND.	THIRD.
1. 50 years.	36 days.	£105.
2. £780.	£1 6s.	19 per cent.
3. £8,321.	£5,600.	£11 13s. 4d.
4. £792 6s. 1½d.	£348 1s. 6d.	30 days.

—o—

Query Column.

RULES.

1. **Each correspondent is restricted to *one question*.** We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. PHOTA.—Extract the square root of 10 by the ordinary rules to 4 places of decimals.

How many more places can you get by simple division?

(*London Intermediate*, 1875.)

```
10(3·1622...Ans.
 9
61 | 100
     61
626 | 3900
      3756
6322 | 14400
       12644
63422 | 175600
        126844
         48756
```

We can obtain (5 — 1) or 4 more places by simple division, that is, one less than the number already obtained.

Thus—

```
63422)487560(7687
      443954
       436060
       380532
        555280
        507376
         479040
         443954
          35086
```

∴ Square root = 3·16227687...Ans.

Note.—See Rule 1, Query Column.

2. LADY FLORIST.—Explain fully the working of the following:—

$$\tfrac{3}{11} + 2\tfrac{5}{9}.$$

$$= \frac{\frac{3}{11} + \frac{5}{9}}{\frac{27 + 55}{99}}$$

$$= 8\tfrac{2}{9};$$

Explanation.—We cannot add $\frac{3}{11}$ and $\frac{5}{9}$ as they are, but we must bring them to the same denomination.

$$\tfrac{3}{11} = \frac{3 \times 9}{11 \times 9} = \tfrac{27}{99}$$

$$\tfrac{5}{9} = \frac{5 \times 11}{9 \times 11} = \tfrac{55}{99}$$

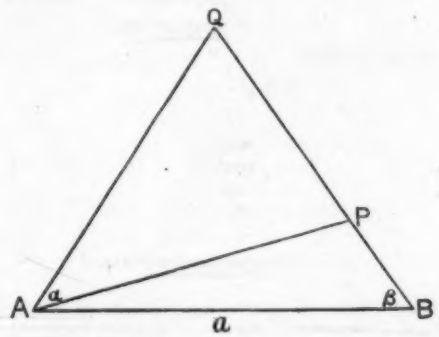
$$\therefore \text{Sum} = \frac{27 + 55}{99} = \tfrac{82}{99}.$$

Wherefore $\frac{3}{11} + 2\frac{5}{9}$

$$= \underline{2\tfrac{82}{99}}. \text{ Ans.}$$

Trigonometry.

1. A. POWELL.—A man walking along a straight road observes that the greatest angle two objects subtend at his eye is α; from this place he walks a yards to the objects, when they appear in a straight line making an angle β with the road. Find the distance between the objects.



Let P and Q denote the objects.

When the triangle PAQ is isosceles, the angle α is a maximum.

Form triangle AQB,

$$\frac{AQ}{AB} = \frac{\sin\beta}{\sin AQB} = \frac{\sin\beta}{\sin\left(90^\circ - \frac{\alpha}{2}\right)}$$

$$= \frac{\sin\beta}{\cos\frac{\alpha}{2}}$$

$$\therefore AQ = \frac{a\sin\beta}{\cos\frac{\alpha}{2}}.$$

Form triangle AQP,

$$\frac{PQ}{AQ} = \frac{\sin\alpha}{\sin APQ} = \frac{\sin\alpha}{\cos\frac{\alpha}{2}}$$

$$\therefore PQ = \frac{AQ\sin\alpha}{\cos\frac{\alpha}{2}}$$

$$= \frac{a\sin\alpha\sin\beta}{\cos\frac{\alpha}{2}}$$

$$= \frac{2a\sin\alpha\sin\beta}{2\cos\frac{\alpha}{2}}$$

$$= \frac{2a\sin\alpha\sin\beta}{1 + \cos\alpha}.$$

Note.—It is evident that the denominator cannot be $\cos\alpha + \cos\beta$, because if $\cos\beta = 1$, the angle β would be 0°.

Mensuration.

1. MANTHE DHOO.—Find the side of an equilateral triangle whose area costs as much for paving at 9d. per foot, as palisading the three sides at 15s. per yard.

$$\text{Area of equilateral triangle} = \text{Side}^2 \times \frac{\sqrt{3}}{4};$$

$$\therefore \text{Side}^2 \times \frac{\sqrt{3}}{4} \times 9 = \frac{\text{Side} \times 3}{3} \times 15 \times 12$$

$$\text{Side}^2 \times \sqrt{3} \times \tfrac{9}{4} = \text{Side} \times 180$$

$$\text{Side} \times \sqrt{3} = 180 \times \tfrac{4}{9}$$

$$= 80$$

$$\therefore \text{Side} = \frac{80}{\sqrt{3}} \text{ ft.}$$

$$= \frac{80}{3\sqrt{3}} \text{ yds.}$$

$$= \frac{80\sqrt{3}}{9} \text{ yds.}$$

$$= \frac{\sqrt{19200}}{9} \text{ yds.}$$

$$= 1'92'00(138{\cdot}564$$

1	
23	92
	69
268	2300
	2144
2765	15600
	13825
27706	177500
	166236
277124	1126400
	1108496
	17904

$$\therefore \text{Side} = \frac{138{\cdot}564\ldots}{9} \text{ yds.}$$

$$= \underline{15{\cdot}396\ldots \text{yds.}} \text{ Ans.}$$

General.

1. F. S.—Your problem is vague and evidently incomplete. Please repeat it correctly.

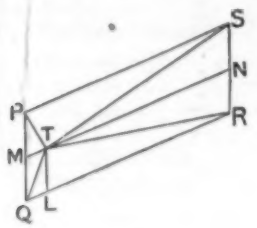
2. E. D.—

KIND OF SENTENCE.	SUBJECT.	PREDICATE.	COMPLETION.	EXTENSION.
(*a*) Principal sentence	(thou)	press	a failing man	too far (not)
(*b*) Principal sentence	it	is a virtue		
(*c*) Principal sentence	His faults	lie	...	open to the laws
(*d*) Principal sentence	(Thou)	let	them, not you, correct him	
(*e*) Principal sentence	my heart	weeps	...	to see him so little of his great self

3. RALPHO (C).—Reasoning, &c. Use Jevon's Primer of Logic, also Sully's Handbook of Psychology. For the rest Dr. Carpenter's Hygiene or Dr. Newsholme's would suit your purpose.

4. BOB-Y-DEGUM.—Solve—T is any point within a parallelogram PQRS, and lines are drawn from it to each of the angles. Show that the △s PTQ and STR = the △ PQR.

(*Schol.* 1890.)



Let PQRS be the parallelogram and T any point within it.

Join TP, TQ, TR, TS. Also join T with M and N, the middle points of PQ, and SR, respectively, and draw TL parallel to MQ.

Then △ PTQ = △s QMT + QTL, and △ STR = △s NTR + RTL.

But these two triangles are together = half the parallelogram PQRS. Also the triangle PQR is equal to half the parallelogram PQRS.

∴ the △s PTQ + STR = △ PQR. Q.E.D.

Algebra.

1. PUZZLED.—Factorise as far as possible :—

$$\left(1-\frac{a}{a+b}\right)^6-\left(1+\frac{a}{a+b}\right)^6. \qquad (\textit{Knight.})$$

$$\left(1-\frac{a}{a+b}\right)^6-\left(1+\frac{a}{a+b}\right)^6$$

$$=\left(\frac{a+b-a}{a+b}\right)^6-\left(\frac{a+b+a}{a+b}\right)^6$$

$$=\left(\frac{b}{a+b}\right)^6-\left(\frac{2a+b}{a+b}\right)^6$$

$$=\left\{\left(\frac{b}{a+b}\right)^3+\left(\frac{2a+b}{a+b}\right)^3\right\}\left\{\left(\frac{b}{a+b}\right)^3-\left(\frac{2a+b}{a+b}\right)^3\right\}$$

$$=\left(\frac{b}{a+b}+\frac{2a+b}{a+b}\right)\times\left\{\left(\frac{b}{a+b}\right)^2-\left(\frac{b}{a+b}\times\frac{2a+b}{a+b}\right)+\left(\frac{2a+b}{a+b}\right)^2\right\}\times\left(\frac{b}{a+b}-\frac{2a+b}{a+b}\right)\times\left\{\left(\frac{b}{a+b}\right)^2+\left(\frac{b}{a+b}\times\frac{2a+b}{a+b}\right)+\left(\frac{2a+b}{a+b}\right)^2\right\}$$

$$=\frac{2(a+b)}{a+b^2}\times\frac{b^2-2ab-b^2+4a^2+4ab+b^2}{(a+b)^2}\times\frac{b-2a-b}{a+b}\times\frac{b^2+2ab+b^2+4a^2+4ab+b^2}{(a+b)^2}$$

$$=2\times\frac{4a^2+2ab+b^2}{(a+b)^2}\times\frac{-2a}{a+b}\times\frac{4a^2+6ab+3b^2}{(a+b)^2}$$

$$=-2\cdot\frac{2a}{a+b}\cdot\frac{4a^2+2ab+b^2}{(a+b)^2}\cdot\frac{4a^2+6ab+3b^2}{(a+b)^2}.$$

Note.—The answer given is wrong in the first factor.

2. PLAISTOW.—Find the present worth of a ground rent of £12 a year to continue for 72 years, compound interest being allowed at 4½ per cent. per annum.

What would be the present value of a perpetuity of £12 at the same rate?

Log 1·045 = ·0191163 ; log 4·20365 = ·6236264.

(*Bankers' Exam.—Final.*)

If P denote the present value in pounds, A the amount of the ground rent in pounds, R the amount of one pound in one year, and n the number of years,

$$\text{Then } P=\frac{1-R^{-n}}{R-1}A.$$

$$R^{-n}=\frac{1}{R^n}=\frac{1}{(1{\cdot}045)^{72}};$$

$$\begin{aligned}(1{\cdot}045)^{72}&=72\log 1{\cdot}045\\&={\cdot}0191163\times 72\\&=1{\cdot}3763736\\&=2-{\cdot}6236264\\&=\log 100\div\log 4{\cdot}20365\\&=\frac{100}{4{\cdot}20365}\\&=\frac{20}{{\cdot}84073}\end{aligned}$$

$$\therefore P=1-\frac{{\cdot}84073}{20}\times\frac{12}{{\cdot}045}$$

$$=\frac{20-{\cdot}84073}{{\cdot}9}\times 12$$

$$=19{\cdot}15927\times\tfrac{40}{9}$$

$$=766{\cdot}3708\div 3$$

$$=£255{\cdot}4569\ldots$$

$$=\underline{£255\ 9s.}\ \text{Ans.}$$

In the second case

$$P=\frac{A}{R-1}$$

$$=\frac{12}{{\cdot}045}$$

$$=\frac{12000}{45}$$

$$=\frac{800}{3}$$

$$=\underline{£266\ 13s.\ 4d.}\ \text{Ans.}$$

3. WEST HAM.—A person aged 40 purchases a deferred annuity of £100 a year to continue for 13 years, beginning when he has reached the age of 60. What must he pay down in one sum for it, if 5 per cent. compound interest be reckoned ; also what yearly premium must he pay during these 20 years to secure the same annuity?

Log 1·05 = ·0211893
log 3·7689 = ·576214
log 1·99872 = ·3007531
log 5·30321 = ·7245391
log 2·6533 = ·423786

(*Bankers' Exam.—Final.*)

Let P denote the present value of the annuity in pounds at the age of 60, R the amount of one pound in one year, n the number of years, and A the annuity ;

$$\text{Then } P=\frac{1-R^{-n}}{R-1}A;$$

$$\therefore P=\left[\frac{1-(1{\cdot}05)^{-13}}{1{\cdot}05-1}\times 100\right]£$$

$$=\left[\frac{1-(1{\cdot}05)^{13}}{{\cdot}05}\times 100\right]£$$

$$\begin{cases}(1{\cdot}05)^{13}=13\log 1{\cdot}05\\\qquad=·0211893\times 13\\\qquad=·2754609\\\qquad=1-·7245391\\\qquad=\log 10+\log 5{\cdot}30321\end{cases}$$

$$\therefore P=\left[\left(1-\frac{5{\cdot}30321}{10}\right)\times 2{,}000\right]£$$

$$=[(10-5{\cdot}30321)\times 200]£$$

$$=(4{\cdot}69679\times 200)£$$

$$=£939{\cdot}358.$$

We now want the principal that will amount to this value in 20 years.

Let S denote the principal in pounds; then

$$P = SR^n,$$

$$\therefore 939{\cdot}358 = S \times (1{\cdot}05)^{20}$$

$$\begin{cases} (1{\cdot}05)^{20} = 20 \log 1{\cdot}05 \\ \quad = {\cdot}0211893 \times 20 \\ \quad = {\cdot}423786 \\ \quad = 1 - {\cdot}576214 \\ \quad = \log 10 \div \log 3{\cdot}7689 \end{cases}$$

$$939{\cdot}358 = S \times \frac{10}{3{\cdot}7689}$$

$$\therefore S = (939{\cdot}358 \times {\cdot}37689)\ £$$

$$\begin{array}{r} {\cdot}37689 \\ \hline 8454222 \\ 7514864 \\ 5636148 \\ 6575506 \\ 2818074 \\ \hline 354{\cdot}03463662 \end{array}$$

$$\therefore \text{Sum} = \underline{£354}. \text{ Ans.}$$

In the second case we want to find A in

$$P = \frac{1 - R^{-n}}{R - 1} A,$$

$$354{\cdot}03463662 = \frac{1 - (1{\cdot}05)^{-20}}{{\cdot}05} A$$

$$= 1 - \frac{3{\cdot}7689}{10} \times 20\,A$$

$$= (10 - 3{\cdot}7689) \times 2\,A$$

$$= (6{\cdot}2311 \times 2)\,A$$

$$= 12{\cdot}4622\,A,$$

$$\therefore A = (354{\cdot}03463662 \div 12{\cdot}4622)\ £$$

$$= £28{\cdot}4;$$

$$\therefore \text{Annual Premium} = \underline{£28\ 8s.} \text{ Ans.}$$

4. EXON.—A building society advances to a depositor a sum of money which is to be repaid by 12 yearly instalments, beginning with £60, and diminishing £5 each year. If their rate of interest be 6 per cent. per annum, how much must they have advanced him?

Given $\log_{10} 1{\cdot}06 = {\cdot}0253059$ and $\log_{10} 4{\cdot}96969 = {\cdot}6963292$.
(*Bankers' Exam.*)

Let P denote the amount advanced in pounds, R the amount of one pound in one year, n the number of years, and A = £5;

$$\begin{aligned} \text{Then } P &= A(R + R^2 + \ldots + R^{12}) \\ &\quad + A(R + R^2 + \ldots + R^{11}) \\ &\quad + A(R + R^2 + \ldots + R^{10}) \\ &\quad + \ldots\ldots\ldots\ldots + AR \end{aligned}$$

$$= A\frac{R(R^{12} - 1)}{R - 1} + A\frac{R(R^{11} - 1)}{R - 1} +$$

$$A\frac{R(R^{10} - 1)}{R - 1} + \ldots + AR$$

$$= \frac{AR}{R - 1}(R^{12} - 1 + R^{11} - 1 + R^{10} - 1 + \ldots + R - 1)$$

$$= \frac{AR}{R - 1}(R^{12} + R^{11} + R^{10} + \ldots + R - 12)$$

$$= \frac{AR}{R - 1}\left[\frac{R(R^{12} - 1)}{R - 1} - 12\right]$$

$$= A\left[\frac{R^2(R^{12} - 1)}{(R - 1)^2} - \frac{12R}{R - 1}\right];$$

$$\therefore P = 5\left\{\frac{(1{\cdot}06)^2[(1{\cdot}06^{12}) - 1]}{(1{\cdot}06 - 1)^2} - \frac{12 \times 1{\cdot}06}{1{\cdot}06 - 1}\right\}£$$

$$\begin{cases} (1{\cdot}06)^{12} = 12 \log 1{\cdot}06 \\ \quad = {\cdot}0253059 \times 12 \\ \quad = {\cdot}3036708 \\ \quad = 1 - {\cdot}6963292 \\ \quad = \log 10 \div \log 4{\cdot}96969 \end{cases}$$

$$\therefore P = 5\left\{\frac{1{\cdot}1236\left(\frac{10}{4{\cdot}9696} - 1\right)}{{\cdot}0036} - \frac{12{\cdot}72}{{\cdot}06}\right\}£$$

$$= 5\left[\frac{2809(10 - 4{\cdot}96969)}{9 \times 4{\cdot}96969} - 212\right]£$$

$$= 5\left[\frac{2809 \times 5{\cdot}03031}{44{\cdot}72721} - 212\right]£$$

$$= 5\left[\frac{14130{\cdot}14079}{44{\cdot}72721} - 212\right]£$$

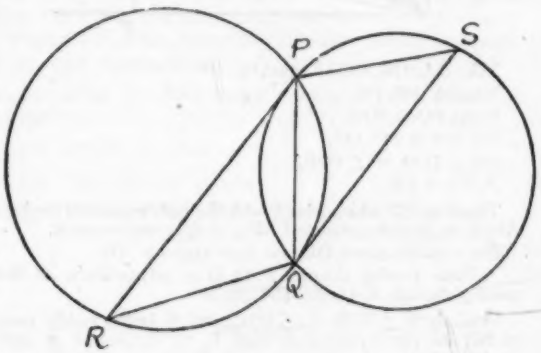
$$= 5(316 - 212)\ £$$

$$= (5 \times 104)\ £$$

$$= \underline{£520}. \text{ Ans.}$$

Geometry.

1. EUCLID.—Two circles cut each other in P and Q. A tangent to one at Q meets the other in S, and a tangent to the other at P cuts the former in R. Show that QR is parallel to SP.

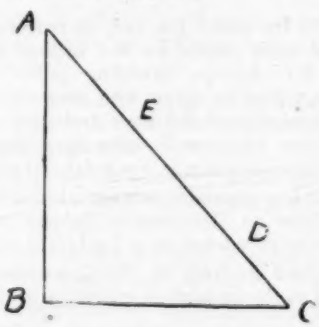


Proof.—Join PQ.

$$\left.\begin{array}{l} \angle PQS = \angle PRQ \\ \text{and } \angle RPQ = \angle PSQ \end{array}\right\} \text{ (III. 32.)}$$

$\therefore$ In triangles PQR, PQS,
$\angle$s QPR, PRQ = $\angle$s PSQ, PQS, and side PQ is common,
$\therefore \angle PQR = \angle QPS$, (I. 26.)
Wherefore QR is parallel to SP. (I. 27.) Q.E.D.

2. GINGER-BEER.—From the hypotenuse of a right-angled triangle portions are cut off equal to the adjacent sides: show that the square on the middle segment is equivalent to twice the rectangle under the extreme segments. (*Potts.*)



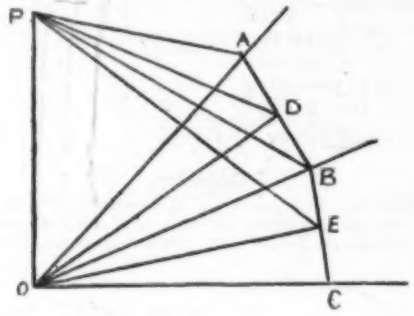
Let ABC be a right-angled triangle, AC being the hypotenuse.
Make AD = AB, and CE = CB.
Then $DE^2 = 2\,AE \cdot CD$.

Proof:

$AC^2 = AB^2 + BC^2$, (I. 47.)
and $AC^2 = AD^2 + CD^2 + 2AD \cdot CD$, (II. 4.)
$\therefore AB^2 + BC^2 = AD^2 + CD^2 + 2AD \cdot CD$
$BC^2 = CD^2 + 2AD \cdot CD$
$CE^2 = CD^2 + 2AD \cdot CD$
$CD^2 + DE^2 + 2CD \cdot DE = CD^2 + 2AD \cdot CD$
$DE^2 = 2AD \cdot CD - 2CD \cdot DE$
$= 2AE \cdot CD + 2DE \cdot CD - 2CD \cdot DE$
$\therefore DE^2 = 2AE \cdot CD$. Q.E.D.

3. F. SPENCER.—OA, OB, OC are three straight lines in a plane drawn from a point O: OP is a fourth straight line not in the plane: show that if the angles POA, POB, POC are equal, they must be right angles.

(*Science and Art Department*, 1885.)



Take OA, OB, OC all equal.
Join PA, PB, PC.
In △s POA, POB,
PO, OA = PO, OB,
and ∠ POA = ∠ POB,
∴ PA = PB.

Therefore PD which joins P with the middle point of the base AB of the isosceles triangle PAB is at right angles to AB.

For a similar reason OD is at right angles to AB.

∴ Plane passing through P, O, D is perpendicular to that passing through A, O, B. (XI. 18.)

Similarly if ∠ POB = ∠ POC, and E is the middle point of BC, the plane passing through P, O, E, is also at right angles to that passing through A, O, B, C.

But the common section of two planes perpendicular to the same plane is perpendicular to that plane. (XI. 19.)

Q.E.D.

Board Scholarship Examination Papers.

As likely to be useful not only to teachers who wish to prepare their pupils for the various scholarships available for children attending public elementary schools, but also to others who may wish to test the general knowledge of the boys and girls under their care, we have pleasure in submitting copies of the questions recently given in a scholarship examination.

The first four papers were essential for all candidates, the last three on Mathematics, Science and Drawing for those who competed for a Technical Scholarship.

We append answers to the questions in Arithmetic, and to the numerical examples in the technical papers.

Arithmetic.

(*Time allowed*, THREE HOURS.)

(All the working must be shown.)

1. Subtract one hundred and eleven thousand two hundred and ninety-four from the product of DCCXLIX. and 304,206.

2. Define *prime* and *composite* numbers. Resolve 22,932 into its prime factors.

3. Multiply 8 lbs. 7 oz. 19 dwts. 23 grs. by 98.

4. A person's income is reduced from £750 to £734 7s. 6d. by income tax; how much does he pay in the £?

5. Multiply $3\frac{3}{20}$ by $15\frac{5}{7}$, and divide $\frac{2}{3\frac{3}{4}}$ by $\frac{2\frac{3}{4}}{3}$; and add together the sum and difference of these results.

6. Express ·37 of £1 17s. 6d. as a decimal of £18·75.

7. How many yards of matting $2\frac{1}{3}$ ft. broad will cover a floor that is $27\cdot\dot{3}$ feet long and $20\cdot1\dot{6}$ broad?

8. A railway train travels at the rate of $52\frac{1}{2}$ miles in $1\frac{3}{4}$ hours. It leaves Cork, according to a clock which is eight minutes slow, at 10·45 a.m., and arrives the same day in Dublin, according to a clock which is 17 minutes slow, at 5.32 p.m. Find the distance between Cork and Dublin.

9. Find the difference between the simple interest and discount of £82 10s. for two years at 5 per cent.

10. A mètre being equal to 39·371 inches, and a frame being equal to 9·38 pence, what is the approximate value in English money of a yard of silk worth $7\frac{1}{2}$ francs a mètre?

11. A house built for £664 is sold for £830; find the gain per cent. If it had been built for £830, and sold for £664, find the loss per cent. Why do these rates differ?

12. What change of income is produced by transferring £2,125 stock from the Three-and-a-Half per Cents. at 75 to the Four per Cents. at 90?

13. M can do a piece of work in 20 days of seven hours, and N can do it in 14 days of eight hours. For how many hours a day should M and N be engaged together that the work may be done in 10 days?

14. At what time between eight and nine o'clock are the hands of a watch together, directly opposite, and at right angles to one another?

English History.

Time allowed, TWO HOURS AND A HALF.

1. Give the dates of the commencement and close of the reigns of the following sovereigns, and name the Royal houses to which they respectively belonged: Alfred, William II., Henry III., Henry VI., Edward VI., Charles II., George II.

2. Under what circumstances, and by what right, did Henry VII., William III. and George I. respectively ascend the English throne?

3. Between whom and with what results were the following battles fought:—Poictiers, Sedgemoor, Naseby, Boyne, Ramillies, Dettingen, Trafalgar?

4. On what grounds were Edward II., Richard II., Henry VI. and James II. deposed?

5. Write a short life of *one* of the following:—Anselm, Wycliffe, Warwick the King-maker, Sir Francis Drake, John Hampden.

7. State briefly what you know about—*The Petition of Right, The Instrument of Government, The Habeas Corpus Act, The Stamp Act.*

8. Name in chronological order six important events in the reign of (1) Charles II., (2) George I.

9. Write an account of *one* of the following events: —Perkin Warbeck's Insurrection, Monmouth's Rebellion, The Defeat of the Spanish Armada.

10. In what directions were the British Dominions increased or decreased during the 18th century?

English Grammar and Composition.

Time allowed, THREE HOURS.

1. Parse fully the words in italics in the following passage:—

'*No* flocks that *range* the valley *free*
To slaughter I condemn;
Taught by *that Power that* pities me,
I learn *to* pity *them*.'

Analyse the following passages:—

(1) 'Far on the deep the Spaniard saw, along each southern shire,
Cape beyond cape, in endless range, those twinkling points of fire.'

(2) 'For severe distress Johnson had sympathy, and not only sympathy, but munificent relief. But for the suffering which a harsh word inflicts upon a delicate mind he had no pity; for it was a kind of suffering which he could scarcely conceive.'

3. Define gender and case. What suffixes are used to indicate gender in nouns?

4. Give the meaning, and when possible the derivation of the following words:—*bushranger, sea-faring, vassalage, gregarious, euphony, martyrdom.*

5. Point out clearly the difference in meaning between—

(1) He shouts; he is shouting; he does shout.

(2) He will come; he shall come.

6. Name four words, each of which can be used as two or more parts of speech, and write sentences to show their different meanings.

7. Underline the affix in each of the following words, and point out its effect: *darkness, drunkard, globule, comical, sweeten, burgess, satchel.*

8. Give in your own words the meaning of the following passage:—

'The mistress of the mansion came,
Mature of age, a graceful dame;
Whose easy step and stately port,
Had well become a princely court,
To whom, though more than kindred knew,
Young Ellen gave a mother's due.
Meet welcome to her guest she made,
And every courteous rite was paid,
That hospitality could claim,
Though all unasked his birth and name.
Such then the reverence to a guest,
That fellest foe might join the feast,
And from his deadliest foeman's door
Unquestioned turn, the banquet o'er.'

9. Correct the following sentences, giving your reasons:—

(1) A few hours' study are enough.

(2) The centres of all the compartments are ornamented with a star.

(3) That friend of my brother's swum across the river.

10. Supply the proper capitals, stops and inverted commas in the following passage:—thelwal thought it very unfair to influence a child's mind by inculcating any opinions before it had come to years of discretion to choose for itself i showed him my garden and told him it was my botanical garden how so said he it is covered with weeds o i replied that is only because it has not yet come to its age of discretion and choice the weeds you see have taken the liberty to grow and i thought it unfair in me to prejudice the soil towards roses and strawberries.

11. Write a short essay on *one* of the following subjects:—

(1) Results of idleness.

(2) The value of rivers.

(3) 'Honour and shame from no condition rise,
Act well your part, there all the honour lies.'

Geography.

Time allowed, TWO HOURS AND A HALF.

1. Give the meaning of the terms—*Isthmus, volcano, equator, equinox, cyclone, glacier.*

2. Explain the cause of tides. How do you account for the occasional recurrence of very high tides?

3. Explain briefly how dew and clouds are formed.

4. State the proportion of land to water on the surface of the globe. Mention the extent in square miles of—(1) Europe, (2) Asia, (3) Africa, (4) America.

5. Name the English counties which touch Scotland, and those which touch Wales, and mention the chief town of each.

6. State the position of the following places and for what each is noted—Dresden, Sedan, Zanzibar, Port Said, Quito, Khartoum, Bushire.

7. Describe generally the West India Islands, and the nature of their commerce, *or* write a geographical description of Egypt.

8. What provinces are included in the Dominion of Canada? Name their chief exports.

9. Enumerate the British Possessions in (1) Africa, (2) Asia; and describe the physical features of one in each.

10. Draw an outline map of Australia *or* Ireland, showing the chief physical features and position of ten large towns.

Elementary Mathematics.

Time allowed, THREE HOURS.

1. Simplify—

$x-[2y+\{3z-3x-(x+y)\}]+2x-(y+3z)$.

2. Find the L.C.M. of $x^2 + 5x + 6$ and $x^2 + 6x + 8$.

3. Add together $\frac{1+x}{1-x}$, $\frac{1-x}{1+x}$, and $\frac{1+x^2}{1-x^2}$.

4. Find the square root of
$4x^2 - 12xy + 9y^2 + 4xz - 6yz + z^2$.

5. Substitute $y + 3$ for x in $x^4 - x^3 + 2x^2 - 3$, and arrange the result.

6. Solve—

(1) $\frac{4x+1}{15} - \frac{5x-1}{3} = x - 2$.

(2) $10x - 4y = 11$, and $3x + 2y = 14\frac{1}{2}$.

(3) $6x^2 - 13x + 6 = 0$.

7. How much rye at four shillings and sixpence a bushel must be mixed with fifty bushels of wheat at six shillings a bushel, that the mixture may be worth five shillings a bushel?

8. Define—right angle, parallel lines, circle.

9. Let DEF be a given rectilineal angle, it is required to bisect it.

10. Parallelograms on equal bases, and between the same parallels, are equal to one another.

11. Show that the sum of the sides of a quadrilateral figure is greater than the sum of its two diagonals.

12. On the sides AC, BC of a triangle ABC squares ACDE, BCFH are described; show that the straight lines AF and BD are equal.

Elementary Science.

Time allowed, THREE HOURS.

1. Explain the terms—*cohesion*, *chemical affinity*, *capillary attraction*, *inertia*. Describe any experiments to show that a body possesses inertia.

2. The plank of a see-saw is 12 feet long. On one side a child weighing 70 lbs. sits at the extreme end; at the other end is a weight of 90 lbs. When balanced how far is the child from the fulcrum?

3. Explain how it is that a long rod is more easily balanced on its end that a short one.

4. How would you use a siphon so as to empty a vessel full of water? Explain why the water flows through the siphon.

5. How would you show *experimentally* that atmospheric air contains oxygen?

6. Explain the action of plants in purifying atmospheric air.

7. Describe the mode of preparation, the properties, and the uses of any two important compounds of iron.

8. Explain what is meant in chemistry by '*a test*.' A bottle is known to contain either carbon dioxide, or nitrogen, or hydrogen; what experiments would you make to find out which gas was present?

9. Explain why a fire-balloon ascends in the air, and why at some point it must stop rising.

10. What different kinds of lenses are there? What is the focus of a lens? Show how it is found in any one case.

11. Describe the mariner's compass, and give some account of its use in navigation.

12. Describe the construction of an ordinary lightning conductor, and explain its action by reference to some simple experiment.

Drawing.

Time allowed, THREE HOURS.

Freehand.

(Not more than ONE *hour and a half is to be allowed for Freehand.)*

Candidates are required to copy in pencil carefully the printed example, increasing the height about one inch, and the width in proportion. No ruling or measuring of any kind is allowed.

[The copy was a trifoliate figure with scroll-like and intersecting curved lines of two different degrees of thickness.]

Geometrical.

1. Draw a line $3\frac{1}{4}$ inches long and erect perpendiculars at the extremities and middle point of it.

2. Construct a square the diagonal of which is 3 inches, and in it inscribe a regular octagon.

3. Draw two lines forming an angle of 60°. Describe a circle of one inch radius touching both lines.

Perspective.

(*Height of the eye 5 feet above the ground plane. Distance of the spectator 12 feet from the picture plane. Scale of drawing $\frac{1}{2}$ inch to one foot.*)

1. Represent, standing on the ground plane, a cube whose edges are 6 feet long, the nearest face being parallel to and 2 feet behind the picture plane. The left corner of the cube to be 3 feet to the right of the spectator.

2. A rectangle 8 feet long, by 3 feet wide, lies on the ground plane, the nearest corner 7 feet to the left of the spectator, and 3 feet behind the picture plane, and the longer sides making an angle of 45°, with the ground line towards the right. On the rectangle place a rectangular block 2 feet high.

ANSWERS.

Arithmetic.

(1) 227,739,000.
(2) $2 \times 2 \times 3 \times 3 \times 7 \times 7 \times 13$ or $2^2 \times 3^2 \times 7^2 \times 13$.
(3) 849 lbs. 3 ozs. 15 dwts. 22 grs.
(4) 5d. in the £.
(5) $49\frac{1}{2}$; $\frac{33}{68}$; 99.
(6) ·037.
(7) $75\frac{3}{8}$ yds.
(8) 208 miles.
(9) Simple interest greater by 15s.
(10) 5s. $4\frac{13}{69}\frac{8}{71}$d., or 5s. $4\frac{1}{4}$d. in nearest coins.
(11) 25 per cent. and 20 per cent. The percentage is reckoned in each case on the outlay.
(12) Income reduced from £74 7s. 6d. to £70 16s. 8d.
(13) $6\frac{3}{8}$ hours per day.
(14) Together at $43\frac{7}{11}$ mins. past 8, opposite at $10\frac{10}{11}$ past 8, and at right angles at $27\frac{3}{11}$ min. past 8.

Elementary Mathematics.

(1) $7x - 2y - 6z$.
(2) $x^3 + 9x^2 + 26x + 24$.
(3) $\frac{3 + 3x^2}{1 - x^2}$.
(4) $2x - 3y + z$.
(5) $y^4 + 11y^3 + 47y^2 + 93y + 69$.
(6) 1, $x = 1$. 2. $x = 2\frac{1}{2}$, $y = 3\frac{1}{2}$. 3. $x = \frac{2}{3}$ or $\frac{2}{5}$.
(7) 100 bushels.

Elementary Science.

(2) $6\frac{3}{4}$ feet.

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Publications Received.

ARNOLD, EDWARD.—Arnold's English Literature Series; Dickens's Old Curiosity Shop (*Yoxall*); Annotated English Classics; Coriolanus (*Hudson*); King John (*Hudson*).

BACON, G. W., AND CO.—Drawing Test Sheets, Standards I. to V.; Excelsior Test Map of Africa.

BELL, G., AND SONS.—Elementary Mechanics (*Horobin*).

BEMROSE AND SONS.—The Electric Light Popularly Explained (*Bromley Holmes*).

BLACKIE AND SON.—Blackie's Modern Cyclopedia (*Dr. C. Annandale*).

CASSELL AND CO., LTD.—Commercial Botany of the Nineteenth Century (*Jackson*); Cassell's Map Building Series.

CHAMBERS, W. AND R.—New Geographical Readers, Standards III. and VI.

CLARENDON PRESS, THE.—Chaucer—The Prologue to the Canterbury Tales (*Dr. Skeat*).

CLAY, C. J., AND SONS.—Elementary Algebra (*Rouse Ball*).

DAWSON, A. G.—The Townley Freehand Test Cards; Technical Drawing Copies, Standards I. and II. (*Bridge*).

FISHER UNWIN, T.—The Story of the Nations; Mexico (*Susan Hole*).

GILL, G., AND SONS.—Infant Ditties (*Cowling*); Kindergarten Drawing Lessons for Infant Schools (*Ellen Richmond*).

GOTCH AND GOMME.—The Gordon Reader.

HEYWOOD, JOHN.—Public Education in Cheshire (*Brunner and Ellis*).

JOHNSTON, W. AND A. K.—Natural History Plates: The Flamingo; The Gazelle.

LAURIE, T.—Roots and Powers (*Dufton*).

LEWIS, SMITH, AND SON.—Copy Books, Nos. 1 and 2 (*Stewart Thomson*).

LONGMANS AND CO.—Elementary Mechanics (*Culverwell*).

MACMILLAN AND CO.—Shakespeare's King John (*Deighton*).

MURBY, T.—Murby's Systematised Civil Service Copy Books, No. 1; Easy Algebraic Products and Factors (*Dodds*).

NELSON, T., AND SONS.—Dictionary of Idiomatic English Phrases (*J. Main Dixon*). Prizes:—The Story of Magellan (*Towle*); Vasco da Gama (*Towle*); Francis Drake (*Towle*); Sir Walter Raleigh (*Towle*); Pizarro (*Towle*); Dulcie's Love Story (*E. Everett Green*); Birdie's Resolve (*E. Everett Green*).

NUTT, D.—French Selections for Translation at Sight (*Matthews*); Wellington College French Grammar (*Eve and D. Baudiss*); German Selections for Translation at Sight (*Bull*).

SMITH, ELDER, AND CO.—The Cornhill Magazine, January.

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Publications Reviewed.

PRIZE BOOKS.

Messrs. Burns and Oates' List.

(1) Tales of Wonder: or, the Inn in the Black Forest. Translated from the German of Wilhelm Hauff.

This book consists of a series of tales of mystery and enchantment strung together in connection with the chance meeting of a number of travellers at a lonely inn in the depths of the Black Forest. The inn turns out to be a robbers' haunt: so the reader can understand the dreadful kind of interest which attaches to the main narrative. The stories with which the travellers while away their time and hush their fears are diversified in subject, but all are interesting.

(2) Historical Tales of Celebrated Women.

These tales are based on historical facts, and deal with interesting episodes of Continental history. The celebrated women whose stories are told in the book are Marie Leczinska, who became the queen of Louis XV. of France; Olga, Grand Duchess of Russia, to whom her country owed the introduction of Christianity; Marietta Tintoret, daughter of a Venetian painter; Isabelle of France, the child-queen of Richard II. of England; and Jean Hachette, who, like a second Joan of Arc, saved her native city of Beauvais. The narratives are interesting, but it may be proper to state that they are written from a Roman Catholic point of view.

(3) Little Snow-white: a Story of the Rheinlands. By Francis Kershaw.

This is a very pretty little story of child life and character, with a thoroughly good moral. The numerous references to religious practices are such as to make it probably more acceptable in Catholic schools than in others; but apart from this feature, we can recommend it as a very pleasing and interesting book for a child.

(4) Arctic Voyages and Discovery: the Exploring Voyages of Dr. Kane, etc.

Like the volumes above noticed, this book on arctic discovery is issued in the publishers' series called the Granville Popular Library. Some expressions in the introductory sketch of arctic exploration seem to warrant the inference that the work is not new, but a re-issue. The interest of its subject is, however, ever fresh; and boys who are not acquainted with the details of Dr. Kane's two famous voyages will be glad to read them in this neatly got-up volume.

Messrs. Swan Sonnenschein and Co's List.

(1) In the Days of Luther: or the Fate of Castle Lowengard. By Esmè Stuart.

This is a well written story of early Reformation times in Germany. The author presents us with a graphic picture of life in a baronial castle in the Black Forest, in the early part of the sixteenth century. The characters are well drawn, the incidents serve to make the story interesting, and mingled with wholesome moral teaching we find a good deal of historical knowledge is conveyed to the young reader. Our sympathies are engaged from the first with the work of the Monk of Wittenburg and his followers, prominent amongst these being Engelbert, the hero of the story. The volume is made attractive by good paper and typography, telling illustrations by C. J. Staniland, and by tasteful binding.

(2) **Maggie in Mythica: or What She saw in Fairyland.** By F. B. Doveton.

The title and substance of this book suggest comparison with 'Alice in Wonderland;' but the style falls far short of that famous work. There are some very pretty passages of description, but most of the pages are disfigured by the use of words unsuitable for children who might be amused with the story. Many of the references, such as that to the use of chloral by fashionable but wakeful ladies, are not of the kind to appeal to children; and the jokes are often near the level of those in a second rate pantomime. Still, Maggie's dreamy wanderings in Mythica may be amusing to some readers, and the printer, binder, and especially the illustrator, T. Harrington Wilson, have done their part to make the volume attractive.

(3) **Life of Joseph Sturge.** By Alexandrina Peckover.

It is well for our boys and girls to read of the deeds of those men who had great influence on our history, but whose achievements were of a kind that is apt to be lost sight of because they are done quietly and without the visible glory that gathers round the doings of warriors and statesmen. Hence we are glad to welcome and to recommend this miniature biography of Joseph Sturge, the apostle of Freedom and Peace, the true lover of his fellowmen. The little book is written in a sympathising spirit, and should teach its readers to appreciate the energy and devotion with which the Birmingham merchant sought to destroy the evils of slavery, war, injustice and intemperance. The motto on the title page, 'Never too busy to be kind,' well sums up the character of his active life.

T. Nelson and Sons' List.

(1) **Dulcie's Love Story.** Evelyn Everell-Green.

Stories of real love like this one are just the right kind of tales for young people. They will read love tales, so by all means put into their hands those which are pure and good. Dulcie and her lovers are the kind of young folk we all wish to see our children grow up into. Marriage could never be a failure if all matches were like Dulcie's. We want more stories for our girls and boys breathing the same spirit of goodness and purity that this one does.

(2) **'Heroes of History' Series. Sir Walter Raleigh, Magellan, Pizarro, Francis Drake, Vasco da Gama.** By George M. Towle.

These five handsome little volumes contain stories from history, and would make capital reading books. As prize books they are suitable for every scholar, being full of thrilling adventure and romance from real life. The ordinary history of a country can only give the merest outline of the lives of its heroes. These beautiful tales supply the missing links.

(3) **Birdie's Resolve.** By E. Everett-Green.

A sweet story, full of sunshine. Birdie, a bonny, natural, and loving little girl, is the means of making peace between father and son, who had thought the estrangement was for life. The tale is told in the style which children love, and Birdie becomes a real little child to the reader, who will feel all the better for having made her acquaintance.

My Edelweiss: or Trial and Triumph. By W. T. Tovani. St. Andrews: Joseph Cook and Son.

A short story with a wholesome moral on the well-worn subject of Temperance. A decidedly religious tone pervades the book, which, in some parts, appears rather too didactic in style. It is dedicated to Professor Henry Drummond.

Chaucer. The Prologue to the Canterbury Tales. Edited by the Rev. Walter W. Skeat. Litt. D. Oxford: At the Clarendon Press.

This school edition of Chaucer's Prologue is thoroughly well adapted to the purpose for which it is intended, namely, as an introductory text book to the study of Middle English and Chaucer's works. The text is based on the Ellesmere MS., but this has been collated with six other important manuscripts, and the various readings are given at the foot of each page. In the introduction, the editor gives a brief statement of the chief facts of Chaucer's life, a list of his principal works, a body of grammatical hints concisely stated, with necessary information on metre, versification, and pronunciation. The notes, which extend over forty rather closely printed pages, afford abundance of the information which the beginner is likely to find most helpful. That the whole work may be depended upon for accuracy no higher warrant could be found than Dr. Skeat's reputation.

The Children of the Castle. By Mrs. Molesworth. London: Macmillan and Co.

A new and beautiful fairy story—'The Children of the Castle.' Two sisters encounter a real fairy princess; but, unlike most fairy princesses she does not bestow her gifts in riches, jewels, &c., but in sweet thoughts and loving deeds, and by guiding the children from wrong to right. The tale is charmingly told, and full of good, plain teaching. The pictures, seven in number, by Walter Crane, are of course exquisite, notably the one of 'Forget-me-not and Mavis,' 'You see me my child.'

Famous Musical Composers. By Lydia T. Morris. London: T. Fisher Unwin.

The biographies contained in this elegant volume are short, entertaining, and to the point. The type is clear and delightful reading. The portraits of the various composers are exceptionally well done. A beautiful presentation book for senior pupils or teachers.

The Red Fairy Book. Edited by Andrew Lang. London: Longmans Green and Co.

This will be a delightful addition to the book-shelves of all young folk. The stories have the quaint old world style lingering around them, dated 'once upon a time.' Most of the tales are very little known, and the old ones appear in quite a unique dress. The book is plentifully illustrated with pictures of fairie's, troll's, and giants of extraordinary shape and humour. The kind of book children will never get tired of.

The Century Arithmetics—Complete. London: Blackie and Son.

The six booklets for the whole of the Standards, which we have previously noticed, have been bound together, and form a good selection of carefully prepared, well graduated exercises in all the rules of Arithmetic required by the Code.

Shakespeare's Twelfth Night, The Tempest, Macbeth, Julius Cæsar. With Introductions and Notes. By K. Deighton, B.A. London: Macmillan & Co.

These four volumes are issued in a valuable series of English Classics specially prepared for the use of students in India. We can, however, recommend them very confidently for students at home. The introductions are very readable and full of serviceable information. They help to put the reader on the right road to a sound understanding of the essence of each play. We note particularly the fulness of the introduction to Macbeth, and the masterly character of that to Julius Cæsar. The text in each case is clearly and carefully printed, and the notes, printed at the end of the volume, are remarkable for their clearness and their copiousness. We would commend them also for the absence of crowding, and of excessive abbreviation. The neat and substantial binding, in light linen cloth, deserves a word of praise.

Gill's Indian Club Exercises: Musical Accompaniments by R. H. McCartney, A. Mus. T.C.L. London: George Gill and Son.

This forms Part III. of the same publishers' Musical Drill, and is got up on similar lines. It contains fourteen exercises with suitable musical accompaniments, the airs of which are mostly selected from the popular operas. The letterpress and illustoations occupy one half, and the music the other half of each opening. The printing is bold, the directions are clear, and the figures are capitally drawn, while the music leaves nothing to be desired. We are of the same opinion as the author, who, in the preface, says respecting the work, 'the exercises will probably prove the most graceful of the series,' of books hitherto published.

Gill's Marching Tunes. Arranged by Thomas Henderson. London: George Gill and Sons.

The preface says 'Popular melodies have been chosen, and the accompaniments so simplified that any one who has gone through an ordinary instruction book will be able to play them at sight. In small schools the teacher will be able to entrust them to a monitor or even a scholar from one of the upper standards.'

To test the truth of this we placed the book in the hands of a little girl in the fifth standard. She entered heartily into the spirit of the music, while two or three little ones did the marching.

The fifty pieces included in the book are varied in their character, but they are all popular and admirably fitted to serve the purpose of the author. A better selection need not be wished.

Chambers' Expressive Primer. London and Edinburgh: W. and R. Chambers.

Three special features are said in the prefatory note to commend this primer. *First*, that the lessons are carefully graduated, and that the language and sentiment are natural; *second*, that each new word is printed at the head of the lesson, and is to be learnt before the reading lesson is commenced, and *third*, that provision is made in each lesson for word-building.

In the graduation no attempt seems to have been made to introduce the vowels and their various sounds systematically. Long and short, broad and open sounds and diphthongs are intermingled indiscriminately. Perhaps this language is natural, but, at the same time, it adds to the difficulty of teaching to read. The primer is splendidly printed and illustrated, and well worthy inspection by infant teachers.

Practical Guide to English Composition and Essay Writing. By W. Stewart Thomson, M.A., F.S.A., F.R.G.S. London: Simpkin, Marshall and Co., Ld.

The special object of this work is to assist candidates preparing for Civil Service Examinations. In the first part of the book the author, who appears to have had very wide experience in the preparation of such students, gives a large collection of typical errors classified and arranged with practical hints for correcting and avoiding them. He claims that 'such a complete collection of representative errors has never before been published,' and this claim is probably justified. Some of the errors, however, are of an extreme kind, and betoken gross carelessness or ignorance on the part of those who make them.

The latter part of the book consists of a large amount of materials for essays, in the form of outlines and quotations, chiefly from the English poets. Some of the subjects are treated fully in specimen essays, a few of which are given as actually written in competitions for the Civil Service. These are satisfactory examples on the whole, though some of the expressions they contain are capable of amendment.

A long list of subjects for additional essays concludes the book, which is well printed and neatly got up.

The Century Geographical Readers. Nos. 1, 2, 6, 7. London: Blackie and Son.

We have been especially pleased in examining these new Geographical Readers. In Nos. 1 and 2 the style is easy, pleasant, and conversational, and the language, on the whole, not too difficult for the standards for which they are intended. Nos. 6 and 7 are descriptive and very interesting. The last contains a considerable number of extracts from some of the most popular modern books, and it will be a considerable advantage to our children to have such a full, picturesque, and agreeable narrative of our colonies, and of our English speaking rivals in the United States. The books are the product of those who know apparently both how and what to teach. We can highly recommend them as most suitable books for the class subject Geography.

Theoretical Mechanics. By H. N. Pinkerton, B.A. London: Blackie and Son.

This covers the course of the first stage of the South Kensington syllabus and similar examinations. The text is clear, the diagrams good, the paper and binding all that could be desired. On a former occasion we were able to recommend very strongly Mr. Pinkerton's Trigonometry, which we are glad to find has been well received. We have no doubt at all that the present volume on Elementary Mechanics will prove equally successful. It seems to us reliable and sound.

Arithmetic of Magnetism and Electricity. By R. Gunn. London: Blackie and Son.

A few words from the author's preface will explain the scope of this book. It is, he tells us, an extension of notes which have been used for some years in preparing classes for the advanced examination of the Science and Art Department. What he has tried to do is to provide the student with easy and intelligent means of solving those and similar problems. There has always been a demand for such help as the author has provided and the demand has been to some extent met. We believe however that there is room for a book like the one before us, and from the examination we have been able to give to it we are distinctly of opinion that the author will have provided what many students will be glad to purchase. The questions are very numerous and are collected from several sources.

The Civil Service History of England. F. A. White, B.A., and H. A. Dobson. London: Crosby and Lockwood.

This is a well known book which has now reached a seventh edition. The fact that there has been a steady demand for it for twenty years is evidence that it has met a want and has been appreciated. The object of the writers was to present the leading facts of English History in an order so simple and so unencumbered by irrelevant matter as to place the candidate in a position to acquire them rapidly and exactly, and to return precise and satisfactory replies to a fair proportion of any set of questions put to him in order to test his knowledge of the subject. The authors have written a fact-book: a book which those who have examinations of a certain kind to pass will do well to consult and study. There is a simplicity, order, and precision about the book which recommend it to a person who has a definite object before him which he wishes to attain. We do not think it is a book which would give a lad a taste for history if he had not one already. It is far too condensed, too full of facts and dates for that; but we agree with the authors that those who are studying the subject in larger and more attractive text books may often wish to consult a book which gives a sort of summary of a period in a few words while at the same time omitting no details of importance.

Models for Latin Prose Composition. By J. Oliver, Bombay Educational Department. London: A. J. Combridge and Co.

This small paper-covered book, printed in a rather unpleasant type, is a collection of short extracts from Latin prose writers—philosophical, oratorical and historical—together with a few examples of Latin letter-writing from Cicero and Pliny. It is probably intended to supply suitable materials for translation and re-translation: but the preface does not decide the question altogether when it says that 'only such passages have been selected as appeared suitable for composition;' and there is nothing else in the book to give any further clue. The passages chosen are printed without comment or classification; except so far as that is obtained by the method of extraction. Thus eighteen passages from the Commentaries of Cæsar are followed by thirteen from Cicero's treatise on the Nature of the Gods, and so on. The putting together of these excerpts has no doubt its uses; as a collection of pieces for unseen translation for instance; its utility might have been increased by the addition of an index. In any case a companion volume of model translations of these passages will be indispensable to complete the design of the work. 'Cicero's Epistolarum ad Diversos' does not strike us as an elegantly constructed title to one of the sections.

Cassell's Public School French Reader. By Guillaume S. Conrad. London: Cassell and Co.

The special feature of this French reading book is that the extracts of which it mainly consists are arranged on a 'strictly graduated' plan based on the order in which grammar is taught. Thus the first part contains none but simple and regular grammatical forms and constructions. The second introduces irregular verbs and easy idiomatic forms. The third includes general practice on the accidence and syntax in the form of two comedies suitable for school performance.

All words as they occur for the first time are printed in clarendon type, and phrases requiring special attention are italicised. By a system of reference numbers, grammatical tables, and a very complete special vocabulary, all the help a pupil should need is conveniently supplied. Etymology receives considerable attention. The book is well printed and should prove very useful.

An Etymological Manual. By K. T. Best, M.A., Oxon. London: Edward Stanford.

In the preface to this book the student will find some valuable thoughts and suggestions on the history and use of words. This will readily be believed when it is known that of the ten pages which constitute the preface, considerably more than seven are extracted from Archbishop Trench's admirable books on the subject. One quotation of seven or eight lines after doing duty in the midst of the preface is repeated by way of closing it.

The body of the book consists of a large collection of Latin and Greek words which form roots of English words, each root being followed by a list of all the most important derivatives from it. No fewer than 9000 words are thus dealt with. Comments and notes are given where necessary to trace the connection between the radical meaning and the use of the derived word. Quotations from Shakespeare, Milton, Hooker, and some other writers are also given to illustrate the use of words. For the explanatory notes, Mr. Best is again very largely indebted to Archbishop Trench.

A Portable Sun-dial. London: George Philip and Son.

Messrs George Philip and Son have published a new and instructive model sun-dial made adjustable for all latitudes. To those who wish to illustrate the principle of measuring time by observations of the position of the sun as indicated by its shadow, this model will be very acceptable. The 'style' may be given any inclination, and the 'dial' may be used to face either north or south by means of the compass attached. The instrument, like all Messrs. Philip's productions, is well made, but somewhat fragile. A table is given for correcting solar to mean time; but we find no table of magnetic variation for the correction of azimuth. This is rather a deplorable omission, and involves a certain amount of error. The box into which the sun-dial fits is one cubic decimeter in capacity, and the bottom of it is divided into one hundred square centimetres in the fashion of a chess board; hence it may be used as an exponent of the decimal system of weights and measures.

The Acts of the Apostles. (The smaller Cambridge Bible for Schools.) London: C. J. Clay and Sons.

The same high standard of excellence is maintained in the last volume of the smaller Cambridge Bible for schools. Only one thing is wanting, as we have pointed out before, to make this series absolutely perfect as text books for young people. The type is too small and the pages too much crowded. In our judgment, the projectors of these valuable books have grievously erred in imposing a task upon children which is almost sure to impair their sight. Why is it that hymn books, bibles, prayer books are printed in smaller type than most other books which are intended to be read?

University Correspondence College Tutorial Series. Analysis of a simple salt. By Wm. Briggs, F.C.S., and R. W. Stewart, B.Sc. London: W. B. Clive and Co.

This volume of about 100 pages is intended to supply all the information necessary to analyse a simple salt. Suitable directions are given for those who depend mainly upon their own efforts, though one may hope that the number of such candidates is gradually decreasing. The type is very good, the general arrangement clear. Diagrams are supplied where they are necessary. We believe that this is likely to prove a useful little book.

Chambers' New Geographical Readers. Standards III. and VI. London and Edinburgh: W. and R. Chambers.

The changes in the Code relating to Geography are the cause of the production of New Geographical Readers. These two volumes are well printed from large type with good illustrations, and in very stiff attractive covers. The style is narrative and descriptive throughout. Standard III. in addition to Geographical facts has lessons on old castles, Grace Darling, Captain Cook, Robert Clive, and Horatio Nelson. More attention is paid to the industries of the population than in former volumes. Standard VI. treats, with the exception of chapters on climate and the interchange of productions, almost exclusively of our colonies, their productions, people, manneer of acquisition, and prominent characteristics. Only words which require explanation are printed along with the lessons, but a full list of the difficult words as well as revision lessons are printed in the Appendix. These books will take their place among the best of the latest series of Geographical Readers.

Universty Correspondence College Tutorial Series. A Text-book of Light. London: W. B. Clive and Co.

This is a text-book on that part of the subject named which is required for the intermediate Science Examination and the preliminary Scientific Examination. It contains about 200 pages. The diagrams are neat and accurate, the printing excellent, and the arrangement of the matter clear and precise. Examples are worked out in full and specimen questions given with their solutions. It forms a suitable companion to several other vólumes on scientific subjects issued in the same series.

The Elements of Euclid, Books I. and II. By Horace Deighton, M.A., Cambridge.

We are glad to find that a new edition of this work is demanded so soon. We noticed the edition of Book I. with appreciation. We can commend the present issue with still greater favour, as the author has in many ways improved it.

In our former notice we drew attention to a sentence in the author's preface, 'To solve questions such as are set in examinations more is required than is to be found in Euclid,' and at the end of the first book of Euclid we find a list of 38 propositions, which are thought to be worthy of study if a candidate is to do himself credit in an examination on Euclid, Book I. We refer to the matter again, because the time must come sooner or later when candidates will be allowed much greater freedom in answering questions in geometry. It is the orthodox faith just now, that mathematics can be nowhere learned as at Cambridge, and at Cambridge students still worship the idol that Euclid set up more than 2000 years ago. When it is urged that the prolixity of Euclid's method is a stumbling block to the beginner and a positive nuisance to the advanced student, who cannot get his work done unless he abbreviates, we are told that if not in the interest of geometry, we must still study Euclid as an exercise in deductive reasoning. It is most gratifying that such a recognised logical authority as Professor Ward entirely rejects this view and would prefer that mathematicians should teach geometry by the best methods at their command and leave the question of logic to be dealt with elsewhere. Euclid will not be deposed yet. We are a conservative people, especially in the matter of educational heresies. We conclude by strongly recommending Mr. Deighton's book; not that he has lifted up his hand against the master, quite the reverse; but while newly translating his work from the original, he has admitted in the sentence we have quoted, that for modern requirements the amount of geometry found in Euclid's Elements is totally inadequate.

Technical Drawing Copies. Standards I. and II. By W. Bridge. London: A. G. Dawson.

A packet of twenty-four well drawn, carefully graduated copies, with a paper of instructions for the teacher, which will be of considerable service to those who are just beginning to teach the subject. If the instructions were printed on cardboard instead of paper they would be more durable.

The Scot's Reader. By David Campbell. London: Blackie and Son.

This book can be used as a text book of Scottish History or a Reading Book for third standard children in Scotch Schools. It gives an easy, picturesque, clear, and agreeable description of Scotland from earliest times till the accession of James VI. to the English throne. It has many illustrations—some to illustrate the notes to the lessons—and revision lessons and lists of difficult words in the appendix. English teachers might do worse than use it as a reading book in Standard III.

The Gordon Reader. London: Gotch and Gomme.

This reader for the upper standards is issued, it is stated, to meet the recommendation of the Royal Commission on Moral Training. The life of Gordon forms the basis of the book, fourteen of the lessons being devoted to it. In addition there are lessons on Stanley, Sister Dora, Father Damien, and many other subjects, all aiming at supplying the matter which will help in the building up of character. The subjects have all been carefully selected, and as the placing of good examples before the minds of the children cannot but be of considerable service, it may reasonably be presumed that sound principles of upright and honourable conduct will get a suitable chance of a permanent lodgment in many young minds. The publishers are to be congratulated on their venture, although, as practical teachers, we do not think it the best plan, educationally, to let the only literary reader in the higher classes of the school be one, the avowed purpose of which is devoted to the attainment of a single end.

The Century Historical Readers:

(a) **Twelve Stories from Early English History: 55 B.C. to 1066 A.D.** By T. Archer. (b) **Twenty Stories and Biographies: 1066—1485.** By T. Archer. London: Blackie and Son.

New books to suit the New Code, and yet containing matter already familiar to all who have Historical Readers in school. The books are suitable for the third and fourth standards of our schools. The stories are broken up into reading lessons of a suitable length, while all the aids which have long been considered necessary in our school books are given. The illustrations are good, the lessons simple, descriptive, and attractive, while the causes of the various changes in English rule from Roman to Saxon, Saxon to Danish, Danish to Norman, and Norman to English, have been cleaaly stated. We commmend these books to the notice of all who have to change their series of Historical Readers.

Advanced Physiography. By John Thornton, M.A. London: Longmans, Green and Co.

Sir John Herschel described Physical Geography as 'The description of the actual state of the earth's surface in its three great divisions, land, sea, and air, as prepared

for the habitation of organic beings, and as exhibiting the play of all those complex agencies, on which depend the distribution of temperature and moisture, aërial and oceanic currents, and those conditions which, under the general title of climate, determine the abundance and limits of vegetable and animal forms.' Physiography, the modern signification of Physical Geography, has a rather different meaning if its scope be gauged by the examination papers set at the May examinations of the Science and Art Department, and works designed to meet the requirements of the South Kensington examiners, must include a fair amount of what would, perhaps, be more properly termed Astronomy.

Mr. Thornton has evidently decided that his work should not fall short of these requirements. He has culled his information from the best sources, and has grouped his facts together in a scientific manner; indeed, it appears that something is said about everything appertaining to the subject. The latest researches are included, Professor Lockyer's work on the meteoric origin of the universe, is well understood by the author, and therefore well described, spectroscopy as applied to the determination of the composition of celestial species is given due prominence, and the whole testifies to the fact that the author is thoroughly in touch with his subject, and the work done in connection with it, up to the moment of going to press.

The illustrations, of which there are 180, are generally well chosen; six maps are given, and a coloured plate of spectra. We would, however, point out one or two things that might be improved. The frontispiece is a plate showing the solar corona during the eclipse of May, 1883, and drawn, we believe, by Trouvelot, but Mr. Thornton must know that the forms shown are impossible, and only exhibit how the most practised eye can be deceived when viewing such phenomena. The plate showing the zodiacal light in the evening sky, given on p. 312, is far superior in every respect, and might have been substituted for the above with advantage.

The illustration of the forms of nebula are also but mournful representations of the most interesting of celestial species. We refer especially to a reproduction of a drawing of the Orion nebula, as it appears to Captain Noble, and to the ring nebula in Lyra. Mr. Roberts has kindly permitted the author to have his famous photograph of the nebula in Andromeda reproduced, and the result is far superior to the other nebula forms given.

There are certain figures that seem to run through all text books dealing with the same subject although the instrument they depict may be obsolete. With such the spectroscope given on p. 74 should be classed, since it represents a form of the instrument very rarely used. Here we should mention that the flutings of carbon, shown on the coloured map of spectra, are wrongly placed. By some mistake the citron fluting is shown on the red side of the sodium line (D), when it should be on its blue side, and the other carbon flutings have also experienced a similar shift towards the red end. It should also be pointed out that the figure given on p. 23 representing the earth's orbit, and the sun's apparent motion among the stars, lacks clearness, and has been constructed with utter disregard to the laws of design, the earth itself being shown in elevation and the orbit in plan.

These are trivial matters, however, when the book is viewed as a whole, and a new edition may, perhaps, see them remedied. That it possesses sterling merit there is no doubt, and we have no compunction in saying it is by far the best book designed for the use of advanced and honours students of Physiography, whilst to those who require a handbook of astronomical information it should be as valuable as its completeness deserves.

Longman's Handbook of English Literature. Parts III., IV., and V. By R. McWilliam, B.A. London: Longmans, Green and Co.

These handy volumes form the completion of a very satisfactory manual, the earlier parts of which we noticed on their appearance Part III. takes us from Ben Jonson to Locke; part IV. from Swift to Cowper; part V. form Burke to the present time. We note the same skilful interweaving of narrative with illustrative quotations which marked the former volumes, and we are struck by the author's evident delight in his subject. Many of the extracts, whether intentionally or not, serve a double purpose; they not only illustrate the style of the author from whose works they are taken, but they supply useful critical comment on the work of their predecessors. Thus we have Dryden's remarks on Chaucer's poetry, Boswell's portrait of Goldsmith, and Carlyle's opinion of Boswell. Then, in the part just issued, we have passages in which J. S. Mill describes the influence of Wordsworth's minor poems, and compares his own powers with those of Carlyle, and Carlyle's comments on Ruskin and his *Fors Clavigera*. We find also Scott's tribute to Byron, Browning's to Shelley in *Pauline*, and stanzas from Shelley's fine elegy on Keats' *Adonais*.

A few pages deal with the chief American writers of the present century in brief but well written notices.

Each part concludes with a summary of the chapters which constitute the body of the book.

After carefully reading the work we have pleasure in warmly recommending it to young students of our noble English literature. All such are likely to find interest and profit in a careful study of these volumes.

Longmans' School Composition. By David Salmon. London: Longmans, Green and Co.

The noteworthy features of this text-book are clearness and precision in the statement of principles and rules, careful graduation of difficulties, aptness of illustrative examples, and abundance of exercises. Dr. Fitch in his *Lectures on Teaching* mentions, as the test of a good manual of any kind, the question, 'Does it, as soon as it has helped the student to *know* something, instantly set him to *do* something which requires him to use that knowledge, and to shew that he has really acquired it?' This test Mr. Salmon's work will stand better than most of the text-books we are acquainted with. Before we reach the 25th section or paragraph we have 27 exercises, and the exercises occupy much more space than the paragraphs of instruction. Their abundance is equalled also by their variety of form. Some capital examples and exercises are given on punctuation, which is treated with particular clearness. The early part of the book includes a collection of short stories such as are given in examinations of the Fifth Standard in elementary schools, and a series of outlines for narratives and easy essays. This first portion includes indeed all that is required for the teaching of scholars in elementary schools. The latter part of the book is more suitable for Middle Class Schools and pupil teachers. It contains some excellent remarks on the choice and arrangement of words; for example, 'Never use a word unless you know the exact meaning of it.' This counsel is developed and illustrated in six fully-printed pages. 'Avoid ambiguity.' 'Avoid all slang.' 'Avoid obsolete words.' All these are dealt with elaborately and, for practical purposes, exhaustively. The author has made a remarkable collection of faulty sentences from the works of standard authors, which have to be amended in accordance with the instructions given in the text. At the close of the book we have a list of over 200 subjects for Composition selected from various examinations, and some very useful 'Notes for Teachers.' The book is one which should speedily become popular.

Liber XIV. Taciti Annalium. Edited by J. R. Worthington, B.A., Trin. Coll., Dublin. London: Longmans, Green and Co.

This is an edition in which there is not much to commend, and a good deal which is open to serious objection. It is professedly made for the use of candidates for the Pass degree at Dublin. Even if we grant that their needs are consulted in such notes as '*Fungatur*, Pres. subj. fungor, functus, 3 dep.,' or '*Angustias*, Angustiæ, plu,' this food for babes should at least have been supplied with some attempt at system and completeness. Take, however, any passage at random; the first three lines of ch. 36 for instance; you find notes of the kind quoted on *silebat* and *miscebat*, whilst with *confideret* and *spernerent* the learner is left to his private resources. And what can be said of the almost entire absence of help towards intelligent comprehension of the not few or inconsiderable difficulties of Tacitus' syntax and literary style? For the bulk of the notes is made up of bare translation of passages, set before the learner without comment, and useless except for the sole purpose of cramming. For notice the incongruity of this pair of consecutive notes:

"*Seges, -etis, f.*"

"*Seque auctorem et socios.* The formation of the plot by himself and the names of his associates."

What chance is there of the student to whom the first is needful information making head or tail of the free rendering of the Latin in the second? Neither notes nor text are free from blunders. In ch. 16, the suggestion of substituting *recreatur* for *cernerentur* is merely incomprehensible: and in ch. 25 the text gives *aggeris*, whilst the translation below implies *aggeri* or *aggeribus*.

Elementary Algebra. By R. Graham, M.A. London: Longman, Green and Co.

Trinity College, Dublin, is famous for its mathematical studies. Some of the best text books on the higher branches of the subject have been written by distinguished Irishmen. We need only name Dr. Salmon, Dr. Williamson, Dr. Casey.

Dr. Graham is already well known from the excellent book on Factors which he published some time ago, and which was favourably reviewed in this journal at the time. The work before us was written with the view to give a student a shorter road to the important parts of Algebra, and not keep him too long at the comparatively useless and mechanical parts of it. There can be no doubt about the excellence of this work. Perhaps the most excellent part of it is that devoted to the subject of Factors. The book is worth buying for that alone. The chapters, too, on Equations are of great merit. In dealing with equations of two and three unknown of the first degree, the author has introduced a first sketch of determinants, without ostentation and parade. It has been the custom lately to introduce this subject in Algebra, but it is often done so that the pupil is led to believe that it is a chapter of the subject which is not intended to be read, at least on a first perusal. Dr. Graham has shown how a determinant can be used, and in so doing has not only reduced the difficulty in understanding the notation, but has given an application of them which is pretty sure to cause a student to pursue the subject further. Though the book only contains 300 pages, it covers the ground usually devoted to a text book of ordinary difficulty. In these days most students use more than one book. This volume would form an excellent companion to one of the three or four by Cambridge mathematicians now most in favour.

Elementary Physics. By M. R. Wright. London: Longmans and Co.

Mr. Wright's book on Sound, Light and Heat, was favourably reviewed in this journal on its first appearance. The present volume is on the same plan. Full instructions are given for the construction of the apparatus described. Mr. Wright has done his work honestly, efficiently, and pleasantly. We have no doubt but that the book will have a wide circulation.

Steam. By W. Ripper. London: Longmans and Co.

This is an admirable handbook on steam, steam engines and boilers. It is intended for students for the South Kensington examinations, and also for practical engineers whose time and opportunities for the study of principles are limited. It will require careful study, but it will repay it. Anyone who masters it—and any intelligent engineer can—will have made at least an excellent start in an important branch of his work.

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